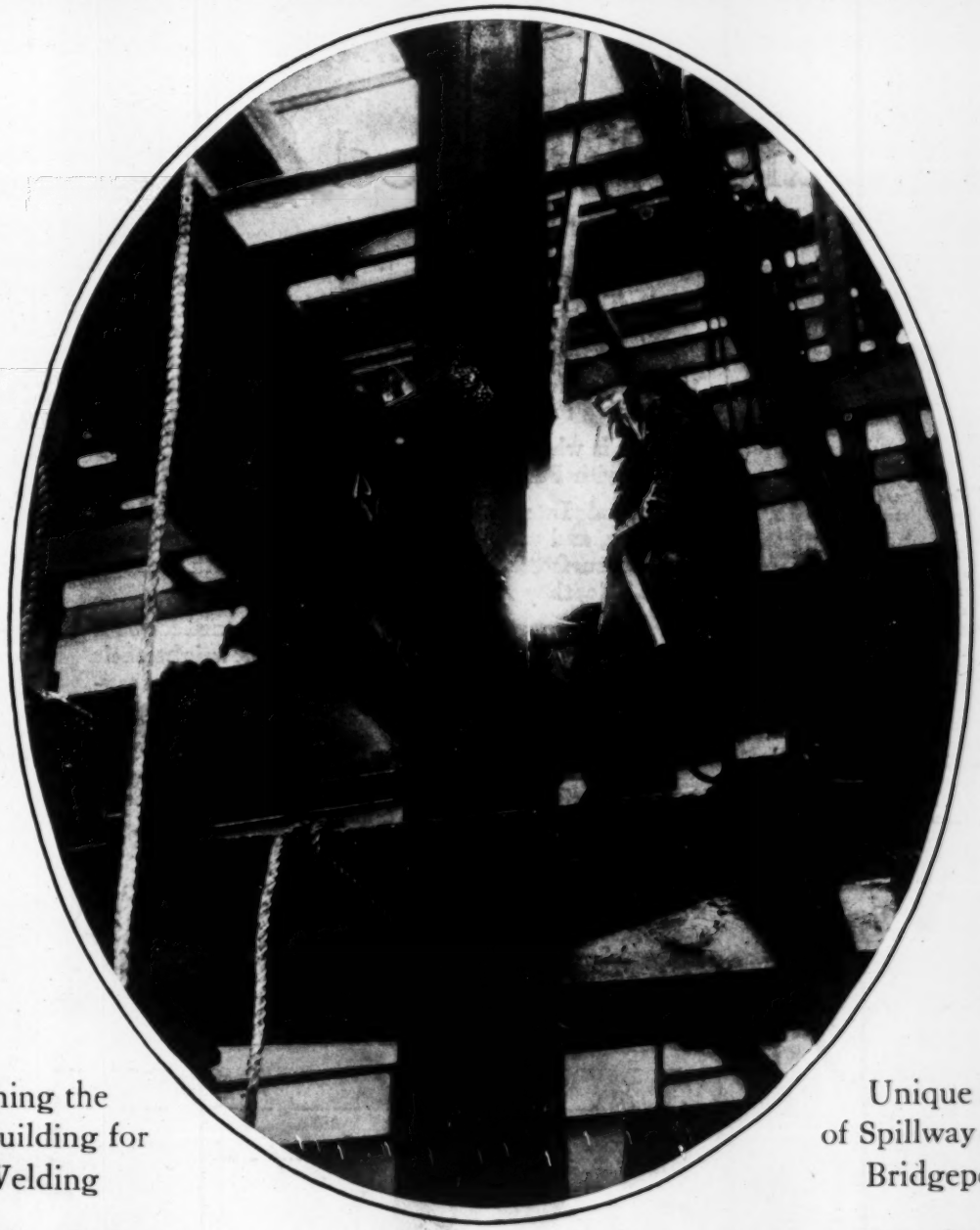
Devoted to Civil Engineering and Contracting. McGraw-Hill Publishing Company, Inc.

January 20, 1927

Engineering News-Record



Arc Welding in Progress on Sharon Building

Designing the Sharon Building for Arc Welding

Staff Report of the American Road Builders' Convention

Unique Solution of Spillway Problem at Bridgeport Dam

Coagulant Used to Reduce Turbidity in New York Water Supply

Federal Roofs

meet every requirement for

Flat and Pitched Surfaces

MADE of concrete, the only truly permanent material, Federal Cement Roof Tile are fireproof, sun-proof, freeze-proof, rust-proof. And they are impervious to moisture, acid fumes and other destructive forces.

That is why America's foremost buildings have been roofed with Federal the past quarter century.

Federal Interlocking Tile require no composition covering, and provide a complete water-proof roof for pitched surfaces. Used in combination with Federal Glass Tile, they form the ideal "daylight roof".

Federal Flat and Channel Slabs are designed for both flat and pitched surfaces. Linked with light weight, their long span not only makes certain a structural steel saving, but also reduces other labor and material costs.

Write today for detailed information about the many other advantages of Federal Roofs. For all flat and pitched surfaces, they are the last word in permanent, no-maintenance construction.

Federal Cement Tile are made of quality-controlled concrete, of great density, accurately reinforced with wire mesh, and thoroughly cured under uniform temperature conditions, thus assuring both lightweight and high strength. They reach the job ready for quick placing the year 'round, and are laid by installation experts who have devoted years of study to the mastery of roofing problems. Federal engineers will assist architects and engineers in laying out steel to carry Federal Tile. This service involves no charge or obligation.

Made, Laid and Guaranteed by the

FEDERAL CEMENT TILE COMPANY

608 South Dearborn Street, Chicago, Illinois

FEDERAL CEMENT TILE ROOFS

"For Every Type of Permanent Building"

A Consolidation of Engineering News, Engineering Record and The Contractor

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

McGraw-Hill Publishing Co., Inc.
JAMES H. McGRAW, *President*
E. J. MEHREN, *Vice-President*

FRANK C. WIGHT
Editor

Volume 98 NEW YORK, JANUARY 20, 1927 Number 3

How Black the Kettle Is

THE *Dearborn Independent*, Henry Ford's mouthpiece, charges that if the government accepts the offer of the Southern "power combine" for a lease of the Muscle Shoals plant and certain rights on the Upper Tennessee River, it will in reality be making a gift to those interests which will be worth millions of dollars over the 50-year period of the lease. When Henry Ford made his offer for Muscle Shoals, an offer that was generally conceded to be of less value than that of the Associated Power Company, he stipulated that the period of the lease be for 100 years!

Another Public Works Department Plan

ENGINEERING Council last week adopted once more a report of a committee recommending a plan for the organization of a federal department of public works. This latest committee has made an exhaustive study which has resulted in a thorough report, in some ways the most reasonable of the many reports which have been made on the subject since Engineering Council called the first conference on the proposed government reorganization in 1919. The report, indeed, is so elaborate and extensive that it does not permit of reproduction in these columns and its abstract must wait for a later issue. One thing, however, may be noted and commended. The committee has abandoned the idea, heretofore firmly adhered to by Engineering Council, that the proposed department must be divided along functional lines with separate bureaus of engineering, architecture and construction. The absurdity of any attempt to allocate governmental activities to any such compartments has always been patent and the committee is to be congratulated in its rejection of the scheme. Whether the sub-division of activities by service requirements will stand any more chance of adoption remains to be seen, but at least the plan now can be discussed on its general merits—and the opposition can be brought to light in its true guise—whereas before the unworkability of the overhead scheme made impossible any real essential discussion.

Structural Welding in Practice

WITH the construction of the just-completed Sharon factory building, structural welding has moved a long step nearer its practical application on a large scale, and the art has entered a new stage of its progress. Heretofore it has been known that on laboratory scale and in minor practical application it is possible to assemble structural steelwork by fusion welding. But the present instance is the first in which the various engineering phases of structural welding for a large tier building were fully worked out. The description of the design, in this issue, clearly brings out that in its detail application the new method permits of the same completeness of calculation and provision for stresses between component elements as is practiced in riveted assemblage. A gain over riveted practice is made in the elimination of lost weight in many details and in the development and utilization of continuity at the beam connections. The possibility of such gain has long been foreseen, but its amount, in this case about 100 tons or one-eighth of the total steel weight, is surprisingly large, and will cover a substantial difference in the cost of making the connections. So far no information has been given on costs in the Sharon case, but this is perhaps not of great importance, as a pioneer job of this kind can hardly be expected to show low costs. In fact the ultimate future of structural welding may not hinge on cost so much as on service value. Among other things lightness, rigidity, permanence, and erection convenience—taking account also of riveting noise or its absence—are likely to be controlling factors. Of course dependability is a vital consideration, and on this we have so far only laboratory tests. The strength tests to be made at Sharon will supply some of the needed confirmatory data, though they cannot entirely replace long-time service. On present information, however, we are justified in taking welded structural work to be adequate in both strength and toughness. With its practicability now proved by a real example on substantial working scale, the new art therefore presents a direct competitive challenge to established practice.

International Scientific Co-operation

GERMAN scientists and their American confreres have finally come to an agreement as to whether a certain ingredient of portland cement is $3CaO.SiO_2$ or $8CaOAl_2O_3.2SiO_2$. Several morals might be drawn from the story, which is told in Mr. Bates' article on page 121. The German scientist comes from an old family organization which has produced portland cement of an enviable reputation for several generations, and yet his family and he himself are so interested in what is sometimes called the academic side of cement production that it sends one of its executives, trained not only in business management but also in physics and chemistry, to this country to co-operate with our Portland Cement Association in the determination of an abstruse point in physical chemistry. It is not particularly important whether the settlement of this question will increase the quality of cement or the knowledge of its proper use. The incident does show that abroad individually and at home collectively cement manufacturers are in earnest in studying their product. It shows that there is a fraternity in science which knows no national boundaries, and it shows a scientific desire to get at the truth and an honesty of acknowledging the truth when demonstrated that would be delightful to behold in other international relations. It shows that the makers of cement are willing to go to a thoroughness of effort

which should be welcome to engineers who want to know how to use cement properly and to feel sure that it is made just as properly.

Water Supply Chances

CHOOSING an additional water supply for a large city is contingent upon many conditions, some of which depend upon chance. Thus, a few weeks ago sources east of the Hudson River were recommended for New York City by its Board of Water Supply rather than going to the Delaware River because of uncertainties as to the fate of the proposed Tri-State Delaware River Treaty between New York, New Jersey and Pennsylvania which has been hanging fire for some time. Last week agreement on a new compact was reached by the tri-state commission in charge and its advisory engineers and lawyers. But the compact must be ratified by the legislatures of the three states and by Congress before it becomes effective, and the Pennsylvania legislature meets once in two years. If by chance the Pennsylvania legislature of 1927 should not ratify the compact then it would have to be deferred for two years. Therefore, whether there is a reconsideration of the recommendations already made to draw water from East-of-the-Hudson sources in favor of a larger supply from the Delaware at less unit cost may depend wholly upon whether the Pennsylvania solons approve the new compact before they adjourn for two years. The new compact, noted briefly in our news pages, gives promise of meeting objections raised against the old one in New York and Pennsylvania so there is hope that it will be promptly ratified by all three states in time for the favorable Congressional action that may be expected in that case if the treaty gets to Congress before adjournment in March.

No Isolated Frontiers

A RECENT letter from the interior of Colombia concludes with the following statement: "The foregoing information is probably too old to be of any interest to you. Your letter first went to Bogota and was sent ordinary mail, while the only reasonably prompt service to the interior of Colombia *is by air mail.*" This statement forcefully brings out the fact that our frontier points are making more practical use of this new mode of transport than are the older and more conservative regions. Colombia needs railways and highways badly to bring interior points into closer touch with the outer world. Meanwhile she keeps them in communication by means of airplanes. A few weeks ago a railroad was completed into an isolated mining region in Northern Quebec. While the railroad was being built and before for nearly two years, hydroplanes not only carried mail but even prospectors and their equipment into the same mining camp. No longer can any place be called isolated from the outside world; a smooth field or an open lake will provide the terminal for means of transport needing no rails or open trail.

Underground Parking Areas

AMONG the many suggestions made from time to time to cure, or alleviate, the traffic congestion evil in cities is the underground parking area. In Detroit some years ago an active mind suggested this construction in the vicinity of the Campus Martius but nothing has ever come of it. Now comes a proposal to turn the subsurface of Bryant Park, back of the New York Library, into an underground bus terminal and public parking space. The scheme has the preliminary backing of several of the public bodies, though so far not enough of its details have been announced to make clear who is to build and operate it and to finance it. Better locations than Bryant Park could be found as far as traffic congestion at its entrances is concerned, but the condition of the park as the result of repeated subway operations near and under it makes it a likely place to attempt this experiment. The idea of turning vehicles underground is as attractive for rubber tired wheels as it is for the steel wheels and rails. One might ask, however, how much real benefit will be gained by storing a thousand or so automobiles off the streets, when there are so many more thousands just waiting their opportunity to occupy the street space so vacated. Bus terminals underground are much more appealing.

Geography and the Road Show

AN EXCEPTIONAL service to the roadbuilding industry is rendered by the Road Show at Chicago. It brings together in one place practically all of the mechanical equipment which has been developed by our marvelous modern road system and which in its turn has made that system possible. The user and maker of these machines and devices both profit thereby, for the time has gone when the individual user can study and inspect all of the machines at their individual salesrooms or each machine builder can reach all the users where they are working. The show has become the common meeting ground for mutual benefit.

The show at Chicago last week served but to emphasize this necessity. Its attendance was up to and at some times over the capacity of the halls and the exhibits were impressive, even though there was not space enough available for those who would show. Both seller and prospective buyer, so far as conversations and report can be trusted, were satisfied that the effort was well worth while and that the Road Show is an important and necessary aid to the forwarding of the mechanical efficiency of roadbuilding. There is, however, a fair question whether the time has not come when some other place than Chicago should be sought.

It is freely recognized that there are few, if any, cities in the country which provide the necessary combination of adequate showing space and hotel accomodations. The Coliseum, and its appendant buildings in Chicago, to be sure, are far from perfect show places and there are some grounds for the frequent complaint that the charges for labor service in moving and erecting the exhibits—charges mostly set by the union rules of the city and not by the management of the show—are exhorbitant almost to the point of extortion. But no city has apparently come forward with equal facilities and, of course, until a show has been staged, no city can guarantee a freedom from the same labor extortion. The only city that apparently has anything to offer that would be fully acceptable from both show space and hotel standpoints is Atlantic City, and the show room there will not be available until sometime in the spring of 1928.

But with all that in mind the fact remains that the managers of the Road Show would do well to recognize that as soon as it is possible a very useful purpose will

be served by giving the East a chance at the show. The show, at least in its preseent proportions and magnitude, developed in Chicago. Its first backers, and among its present largest exhibitors, are the manufacturers in the Middle West. The main attendants are from the great road-building states that consider Chicago the country's metropolis. But there is a great roadbuilding country east of the Alleghenies which the show is not serving. It may cost some of the manufacturers a little more to move their equipment there, but the movement need be but one way for they can always sell it. There may be some of the Middle Western roadbuilders who would hesitate to take the long trip east, but there are places in the east which the westerner likes to visit. And there would be to draw upon a whole new reservoir of men to whom the accumulated collection of the latest roadbuilding equipment would be a revelation that later would be transmuted into greater use of the perfected machines—to the benefit of the road user and of the manufacturer, too.

The time for such a move may not yet have come. But the directors of the show, who are studying the possibilities of a move, should realize that there is a strong demand for an Eastern exhibition at least in alternative years with the Western show. This demand they can satisfy—if they can find the proper place—but if they do not supply it so much pressure may be brought to bear by engineers and contractors that an Eastern show will some way be started and there will result a division and competition of interest, expensive to those who show and unsatisfactory to those who come to see and study.

Sound and Unsound Business

A NEW bill for the development of the Boulder Canyon project on the Colorado River is now pending in Congress. Important as the subject was during last year's session, changed physical conditions make it far more important now, and there is reason to believe that a large section of Congress appreciates this fact. The new bill differs only in form from previous Boulder Canyon bills. Essentially it contemplates flood protection, power development, irrigation and domestic water supply in a joint project. The general purposes and objectives of the bill may, however, be left for later discussion. For the present we wish to point out a distinctive feature of the Boulder Canyon project, namely, the requirement that the beneficiaries of the improvement shall pay interest as well as principal of the construction cost. This requirement introduces a new method into federal development of the Far West—sound business method in place of the unsound and demoralizing methods that have prevailed until now.

Hitherto Western improvement work done at national expense has been carried out free of interest charge. Under the famous Reclamation Act of 1902, still in force, the beneficiaries of federal irrigation and power development are required to repay the principal of the cost of the work, in long deferred installment payments, without interest. This provision obviously constitutes a direct subsidy, or more plainly speaking charity, to those owning land under the improvement. It is quite incongruous to expect that sound business could develop on a charity basis, and in fact the no-interest proviso has laid a curse on government reclamation, and indirectly on all subsequent irrigation development.

Fortunately, the Boulder Canyon project is planned to avoid similar evil consequences, by making it a definite and basic requirement that interest shall be paid on the government's expenditure. In the detail application of this requirement the bill as now written is not wholly clear. It may be interpreted as placing the full interest burden on the power licensees while leaving the irrigation licensees free to repay principal only, under the Reclamation Act. But the language of the bill is to the effect that the *initial* applicants for water use shall engage themselves to repay cost with 4 per cent interest, as a condition precedent to construction, and in equity, of course, the same obligation must be held to rest on subsequent applicants for use of the water. The matter of interpretation presumably will oe clarified before the bill proceeds in Congress. For present purposes we may assume that the flood protection element only is a federal contribution, while irrigation, power and domestic water supply are placed on a repayment-with-interest basis.

Under such a provision, sound development is invited and encouraged; unsound development—enterprise that is unable to meet its fixed charges—is discouraged. It is an epoch-making innovation to establish this attitude toward land exploitation as well as toward power exploitation. Both are subject to the same rules of sound business, and both are equally subject to the penalties of their violation; yet, though power development has always been required to pay its way, Western land development has for 25 years been conducted on the golden-spoon plan. With the Boulder Canyon bill this plan is abandoned and the pay-as-you-go plan substituted. The change awakens the brightest hopes for Western irrigation development, which is bound to flourish when the new plan is applied universally.

Simultaneously with this innovation in the Southwest, a directly opposite plan of action is being agitated for the Northwest. The first steps have been taken by the federal government toward spending ten to twenty millions on irrigation works for two Oregon tracts which will need the full advantage of 40-year repayment without interest in order to survive. A third tract of land, which cannot pay even on these philanthropic terms, is about to be included by Congress in the current appropriations, with mandatory directions to the Department of the Interior that it carry out its development regardless of the infeasibility of the project.

Thus the subsidy or charity principle of development is to be carried a step farther than has even been done in the previous history of the United States. Irrigation in Oregon is already in a sorry state, many of the projects being virtually bankrupt. Its condition is hardly likely to be bettered by federal attempts at hothouse development of undertakings which must later withstand the more rigorous experience of self-supporting existence.

The conflict of plans between proposed Northwest and Southwest developments is interesting. It suggests that national policy with respect to Western development is at a parting of the ways. We hope and believe that the method exemplified in the Boulder Canyon bill represents the coming policy. The extreme attempts being put forth by the Northwest to profit by federal charity may represent perhaps the last effort of a generation of pork-hungry politicians to reap local benefits through a policy that has been outlived.

Designing the Sharon Building for Arc-Welding

Successful Construction of Five-Story Factory Building of Westinghouse Electric & Mfg. Co. Required Many Departures from Usual Practice—Continuity of Beams Utilized to Secure Economy

By Gilbert D. Fish
Consulting Engineer, New York City

THERE has lately been completed the arc-welded steel frame for a five-story manufacturing building for the Sharon works of the Westinghouse Electric & Mfg. Co. This structure is distinguished from previous welded structural work by its size, by its heavy-duty construction, by its novel joint details, and by its basis of design. Apparently it is the first building structure designed expressly to suit welded construction; in earlier practice it has been customary to design as for riveted construction and to modify the connection details for welding.

The project was carried out under the general direction of W. S. Rugg, vice-president of the Westinghouse company. The structure was designed by the writer from plans by the architect, B. H. Prack of Pittsburgh, and was fabricated and erected by the American Bridge Co., which executed the welding, both shop and field, with technical co-operation of the Westinghouse company. A. M. Candy, Westinghouse welding engineer, supervised and inspected the welding. A. H. Wessell, architect's engineer, consulted on structural matters and designed the foundations.

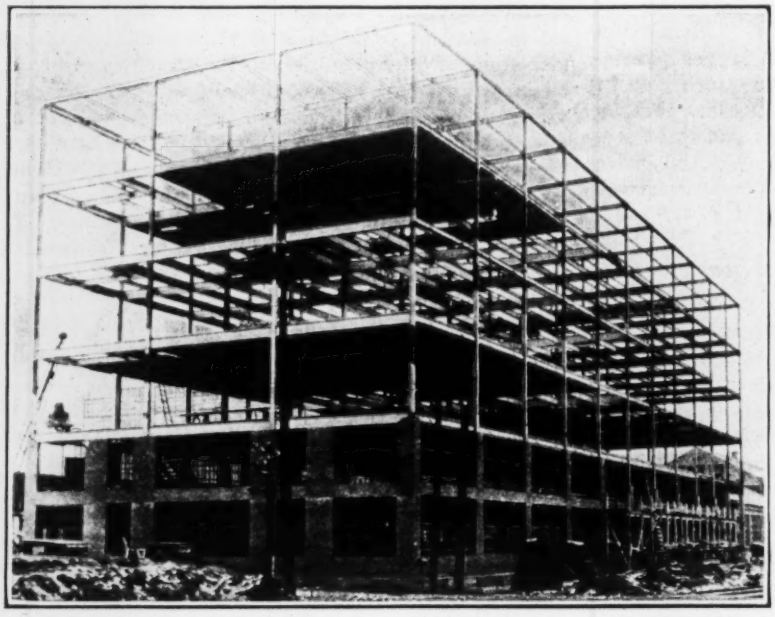


FIG. 1—COMPLETED FRAMEWORK OF SHARON BUILDING, AND VIEW IN CRANEWAY

Type and Arrangement—The building is 70 x 220 ft. in plan and 80 ft. high, with five stories and mezzanine but no basement. Its construction comprises the welded steel skeleton, splined wood floors, and 8-in. brick walls carried by the steel. Columns divide the plan into 33 panels 20 x 23 ft. The floor live-load is 200 lb. per sq.ft. for girders and columns, but 300 for beams to allow for special concentrations and suddenly applied loads. The working stress for bending in beams and girders is 18,000 lb. per sq.in. The same base stress was used in proportioning the columns, with reduction for length.

Fig. 2 shows half plans of the second and third floors, the latter similar to the fourth and fifth floors, except for minor differences near the elevator shaft. In the second floor note the plate girders, in pairs, carrying the line of four-story columns on 45-ft. span over the craneway. The partial mezzanine contains no important feature distinguishing it from the floors above, except that the girders are 24-in. instead of 20-in. because they cannot be made continuous with interior girders. The roof plan is similar to the typical floors; interior beams are 7-in. I's (8-in. I's in two bays at each end to take care of greater negative moment at first interior line of girders), while typical interior girders are 12-in. I's (those forming the first interior line at each end are of extra weight). At all tiers the design of girders and spandrels at the south end has been adapted to future extension of the building southward.

Design for Continuity—Wherever the layout permits, beams and girders are designed for complete continuity. To appreciate the significance of this it is necessary to realize that welded joints properly designed for the purpose are capable of developing the full negative bending strength of the beams at their supports. This peculiar property of the welding process imposes upon the designer the necessity for studying continuity with the object of saving steel. On this job about one-eighth of the total tonnage, or roughly 100 tons, has been saved by continuity; this saving, however, has been at considerable extra expense in welding to effect continuity.

The figures for a typical line of eleven beams and a typical line of three girders will be given.

The typical floor dead-load is 23 lb. per sq.ft. including beam weight; live-load for beams 300; total load per linear foot of beam 7 2/3 x 323 = 2,480 lb. The three-moment equation applied to eleven equal spans under uniform load with same moment of inertia gives $0.106pL^2$ or 105,000 ft.-lb. for the negative bending moment at the first interior support, and $0.085\ pL^2$ or 84,000 ft.-lb. at the third interior support; the moments at all other supports are very slightly less than the latter figure. The excess moment at the support between first and second spans requires heavier beams in those spans, and causes a change in moment of inertia at the second interior support; it is unnecessary to take this into account because the error from neglecting it in the use of the three-moment equation is trivial, but the diagrams in Fig. 5 are based on calculations which allow for the change in the moment of inertia at these supports.

The negative moments given above are the values to be developed in the welded connections, but are not the values to use in selecting the beam sections; the critical sections of the beams are at the extremities of the seat angles or seat plates to which the bottom flanges of the beams are welded, 6 in. or more from centers of supports. Due to the rapid variation of moment in terms of distance near supports, the design moments for beams are considerably less than the design moments for the continuous joints; 6 in. away from center of first interior support the moment is 90,000 in the end span and 92,000 in the interior span; 6 in. away from third interior support, in either of the adjacent spans, the moment is 72,000. Beams 15 in. by 50 lb. are used for end and first interior spans, maximum stress 17,200 lb. per sq.in. at 92,000 ft.-lb. moment; beams 15 in. by 42.9 lb. are used for other spans. The maximum bending moments for full load might be very slightly increased by removing all live-load from certain panels, but there is no need to assume such extreme conditions.

The beam reactions at the first interior lines of support are 13 per cent greater than full panel load, due to continuity, while at other interior supports the reactions closely approximate the panel load; therefore the first interior line of support near either end of building is designed for 13 per cent more load than the others. At the ends of the building the beam reactions for full load are 21 per cent less than the values for simple beam conditions, but in designing end girders and columns one-third of this advantage is arbitrarily discarded to allow for partial unloading of the first interior span.

For a typical line of girders continuous over three 23-ft. spans, with third-point loading, the figures are: Each concentrated load, on basis of 200 lb. live-load and 26 lb. dead-load, is 226 x 153.3 = 34,600 lb. Negative moment at center of either interior support is 4/15 x 34,600 x 23 = 212,000, but at the critical section of the middle girder, 12 in. from the column center, it is 177,000. At the critical section of either end girder it is very slightly less. The girder section for all three spans is 20 in. x 65.4 lb. For first interior line of girders near either end of the building, the stresses are 13 per cent greater, and the section used is 20 in. x 75 lb.

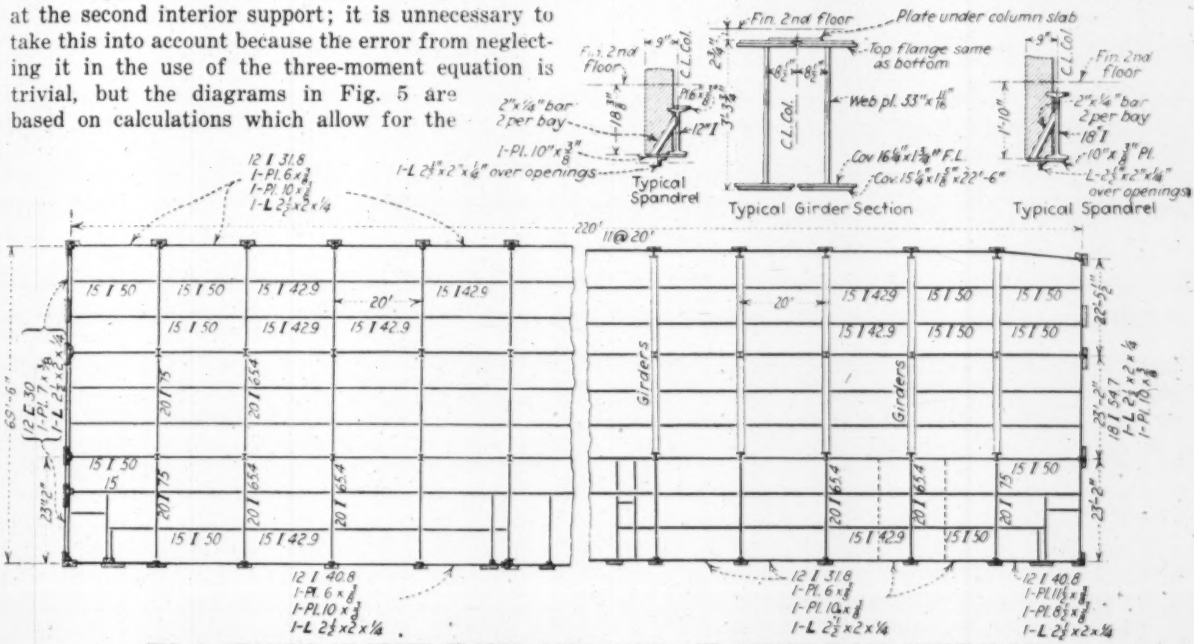


FIG. 2—FRAMING OF UPPER FLOORS (LEFT HALF) AND SECOND FLOOR (RIGHT HALF)

Plate Girders—The plate girders in the second floor occur in pairs, each pair supporting a column at mid-span and five pairs of beams. These girders are assembled from plate material without angles or other shapes. Each typical pair of girders is designed for the dead-weight, plus 200 lb. live-load on all floors, second to fifth, plus 40 lb. live-load on roof. The column load is 368,000 lb. and each pair of beam reactions is 34,600 lb. Dead-weight of pair of girders is 36,000 lb. The span center to center of supports is 45 ft. End shear is 288,000 lb., and the center bending moment is 5,510,000 ft.-lb. Fig. 6 gives the shop drawing for a single girder. The section modulus including cover plates is 1874, or for the pair of girders 3748; the maximum bending stress is 17,800 lb. per sq.in.; the mean shear in the webs at the ends is 6,300 lb. per sq.in. Note the stiffeners which brace the web plates and flanges; unlike stiffener angles in riveted plate girders, these stiffener plates are connected to the flanges as well as to the web plates.

Two pairs of girders carry heavier loading than the others due to excess beam reactions on all floors at the first interior line of support at each end of building, and are correspondingly heavier.

Columns—For the columns standard 8-in. H-sections are used where the loads are not too great, and elsewhere 8-in. plate-and-angle sections, except under plate girders. The column formula is 18000 — 80 l/r. The column loads are affected by the continuity of the beams and girders, interior columns carrying more of the floor and roof loads than would be indicated by area-load calculations; for wall column loads one-third of the reduction due to continuity has been discarded, as an arbitrary safety measure to allow for missing live-load on interior panels. The shapes composing the plate-and-angle columns are assembled by shop welding (Fig. 6). The use of the so-called constant-dimension columns, in which there is no change in outside dimension where the column section changes, avoids the use of load-carrying splices.

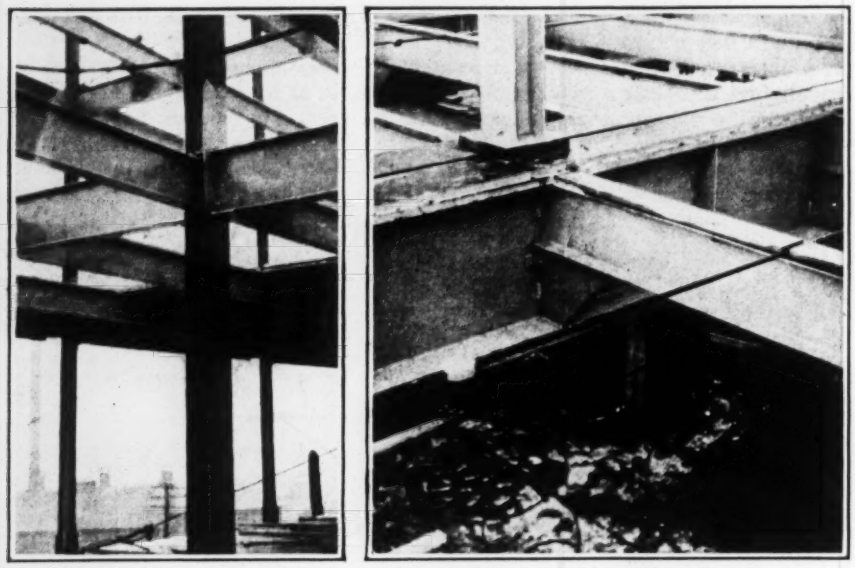


FIG. 3—WELDED FRAME SEEN FROM SECOND FLOOR, AND CONNECTIONS TO A HEAVY PLATE-GIRDER

In numerous places throughout the building there occur I-beams with welded flange plates. These are used wherever head-room requirements prohibit the use of unreinforced I-beams. In some cases these flange plates do not extend full beam length; in nearly every case the upper plate is made to serve as a shelf for brick masonry.

Connections—The designing of the welded connections was based on strength data assembled from various sources, but mainly on the findings of tests recently conducted at Pittsburgh, and reported in *Engineering News-Record* of Aug. 12, 1926. The typical beam and girder connections were patterned after joints which were proved adequate in those tests. Generally, the welds are of two types: (1) butt welds, which fill prismatic gaps between faces of members connected and transmit any kind of stress in the same manner as if the members were actually butted in contact and fused together; (2) fillet welds, triangular prisms which join faces forming re-entrant angles. The typical fillet weld in this building is ⅜ in. along each leg of the right triangular section, exclusive of penetration.

A perfect weld occurs in case of complete fusion at suitable temperature, without voids or foreign materials. Inasmuch as we cannot count on perfect welds, it is necessary to design for lower working stresses than would be indicated by the strength of the weld metal itself. The available data, which cannot be considered exact or comprehensive, have led us to limit tensile and shearing stresses to 10,000 lb. per square inch of the surface of fusion, but the use of beveled reinforcing plates and combinations of fillet welds with butt welds results in obliquity of stress with respect to fusion surfaces, and makes it possible to develop the full tensile strength of such reinforcing plates (see Fig. 6). It is not necessary to place a figure on crushing stress, because no possible loading would produce enough compression to crush the weld metal confined in a narrow crack.

In Fig. 6 is included a detail of the beam and girder connections at a typical interior column. The typical girder connection is designed to resist the negative bending moment of 200,000 ft.-lb. The plates inside the column opposite top flanges of girders are intended to transmit most of the 120,000-lb. tension developed by this negative bending, which would otherwise pull the column flanges outward. The outstanding leg of the seat angle under each 15-in. I is butt-welded to the column flange to protect against the thrust of the girders at the bottom. The typical 15-in. I-connection is designed to resist the negative bending moment of 67,000 ft.-lb. The connection of 15-in. I-beams to 20-in. girders, both for the typical interior beam and the 50-lb. beam used in the end panels and

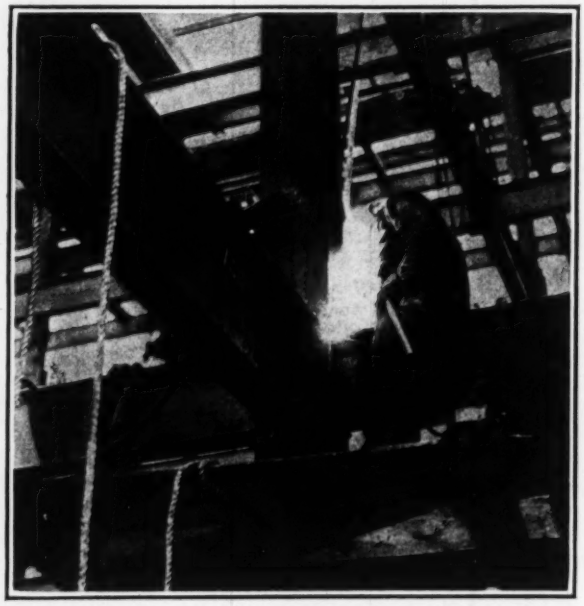


FIG. 4—FIELD WELDING IN PROGRESS AT SHARON

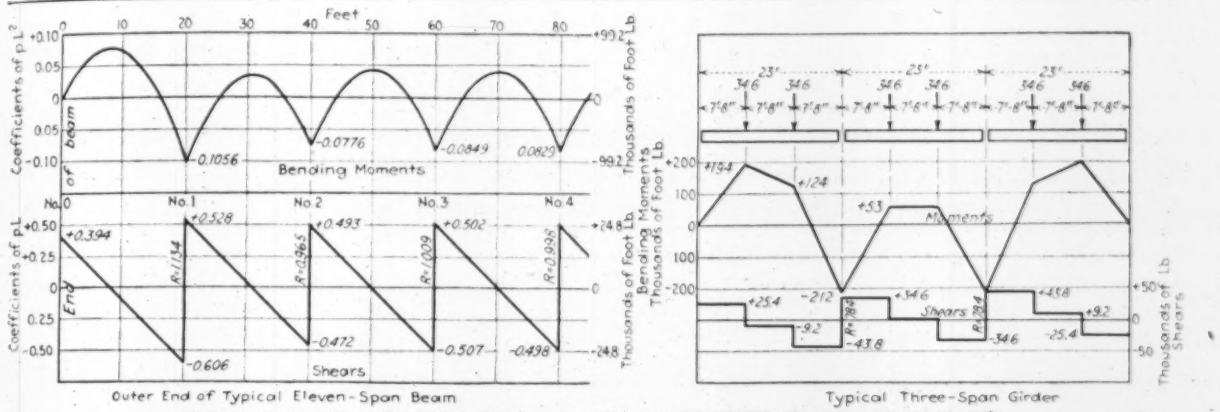


FIG. 5—MOMENT AND SHEAR DIAGRAMS FOR CONTINUOUS BEAMS AND GIRDERS

first interior panels, is also shown, as are some other representative details.

The fillet welds transmitting shear between web and flanges of the plate girders are intermittent and vary from 83 per cent continuous at the ends to 67 per cent at the middle. The end shear is 144,000 lb.; with depth of web 33 in. the shear between web and flange is 4,370 lb. per lineal inch, and as the welding is 83 per cent, the pair of fillet welds at either flange carries 5,240 lb. or each ⅜-in. weld 2,620 lb. per lineal inch. This is less than 10,000 lb. per sq.in. and allows a margin for possible secondary stresses or inequality of distribution. The decrease in welding near the middle of the girder corresponds to decrease in external shear. The welding of cover plates to main flange plates is based on similar calculations. The welding of stiffeners has been established empirically, being related mainly to the thickness of the web plate. A considerable part of the plate-girder welding was done with a Westinghouse automatic welding machine.

Shopwork—The American Bridge Co. assigned one of its fabricating shops at Ambridge exclusively to the shop welding on this job, and installed there Westinghouse welding equipment to serve sixteen welders. As much as possible of the welding was handled in the shop. Shop welding included all assembling of built-up columns and girders, welding of outrigger lintels to beams, and welding of seat angles to columns. All beams and girders were milled to length in order to facilitate field welding by providing predetermined end clearances. All columns were milled to bear.

Erection Provision—Two holes were punched in the bottom flange at each end of every beam or girder for erection bolts; corresponding holes were punched in seat angles. Likewise four holes were punched near the bottom of every column (except in bottom tier), corresponding to holes in splice plates welded to the column below. The erection bolts enabled the erectors to proceed in the usual manner, except more wire rope was used to hold members in position than ordinarily.

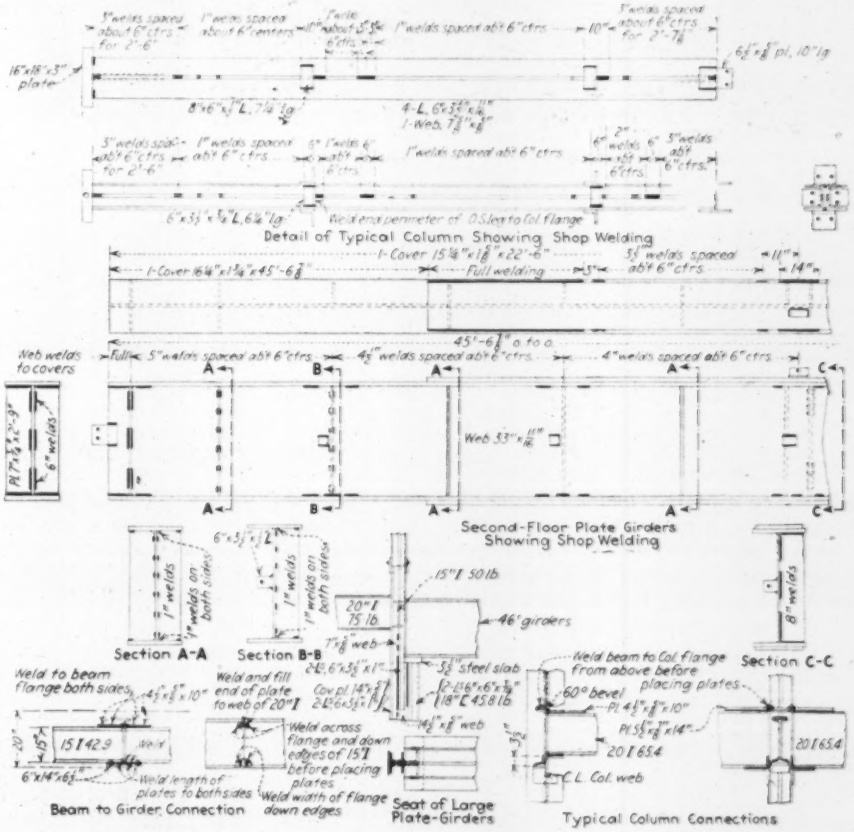


FIG. 6—COLUMN, PLATE-GIRDER AND WELDED CONNECTIONS
Sketches of joints show field welding only.

The welders, who numbered not more than sixteen at any one time, did most of their work from small portable scaffolds slung from the girders (Fig. 4). Each welder had an individual welding cable extending from his electrode holder to the welding machinery housed on

the ground floor. No helpers were employed; the welders moved their own scaffolds, cables and electrodes. The field welding machinery consisted of ten Westinghouse motor-generators: nine single-operator units of 200-amp. rating, and one multiple-operator unit of 1,000-amp. rating with resistance boxes to serve seven welders.

All welding operators employed on shop and field work received special training in the Westinghouse welding school before working on the job. Several of those selected for training were dropped without being used on actual construction; of those found dependable, the most expert were used on the most difficult joints. Great care was given to close supervision and systematic inspection of welds, and occasional welds which were considered doubtful were cut out and done again.

Proof Testing — Tests are to be applied to typical beams and girders. Instead of the slow and expensive method of testing by piling up weights, it is proposed to apply mechanical forces with anchorage to the structure itself; equipment for this purpose is now being constructed. This proposed testing is intended as a demonstration only, it being the firm opinion of those connected with this building operation that the precautions already taken insure satisfactory strength.

Accurate time records have been kept in shop and field, but the data have not yet been fully assembled, and it is impossible at this time to state the costs.

Safety Medals Presented to Three Railroads

The Harriman medals awarded through the American Museum of Safety for effort in the preservation of life have been presented to three railroads: the gold medal to the Union Pacific R.R. for the fact that during the last four years this road has saved 2,881 employees from death or serious injury by its safety appliances; the silver medal to the Duluth, Missabe & Northern Ry., and the bronze medal to the Green Bay & Western R.R., which had no fatalities last year.

Port Improvement Being Made at Buenaventura, Colombia

Berthing Facilities for Deep Draft Vessels to Replace Old Dock—New Railroad Yards and Warehouses

ENLARGEMENT of the port facilities at Buenaventura, Colombia, is being undertaken by the Ferrocarril del Pacifico, a government owned and operated railroad, in order to relieve the congestion which now exists there, due to the continued extension of the railroad and the influx of traffic diverted from other channels, chiefly from the Magdalena River. The existing facilities consist of a pier 480 ft. long by 100 ft. wide with a depth of water alongside the pier of 22 ft. at low tide. This property was obtained by the government in October, 1925, and plans were made at once to enlarge and extend the facilities. Present plans call for a berthing wall 3,280 ft. long with approach channel and berthing space having a depth of 35 ft. at mean low tide. This will make it possible for the larger ships to call at the port. Between the wall and the higher land to the east and south, dredged material from the channel will be pumped in to provide new ground upon which to build railway yards and warehouses. Three warehouses of 50,000 sq.ft. of storage each will be built as part of the first step. The layout of the port is shown in Fig. 1.

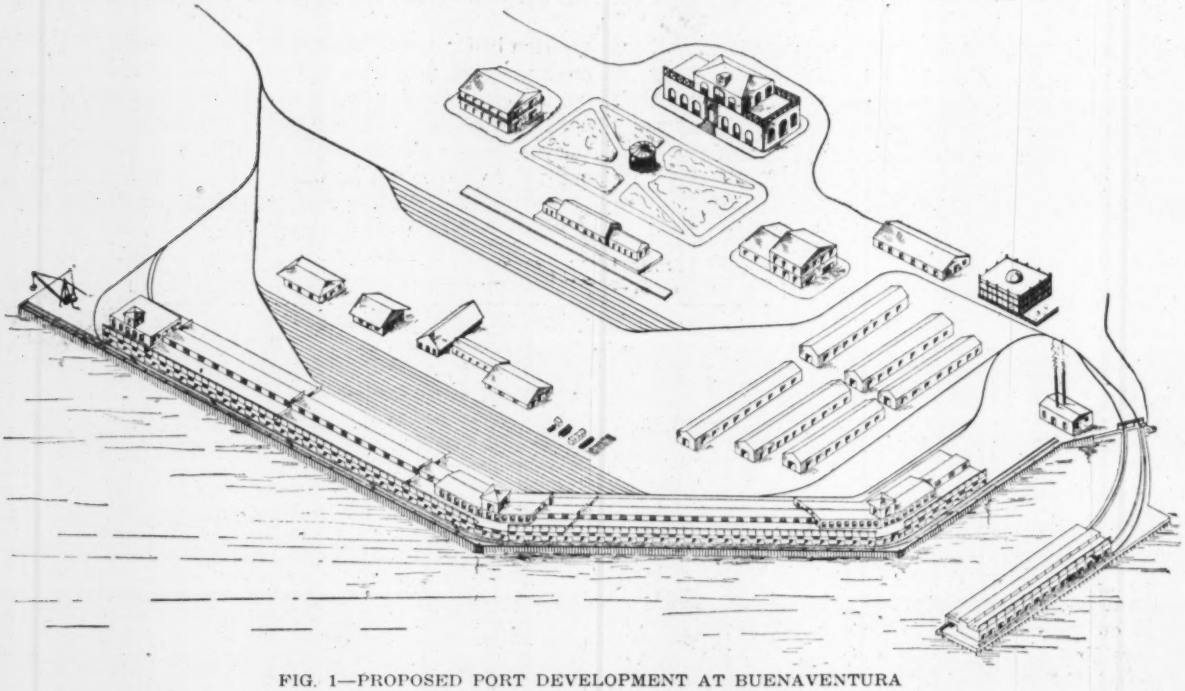


FIG. 1—PROPOSED PORT DEVELOPMENT AT BUENAVENTURA

The Port of Buenaventura, Colombia, is on the Pacific Coast 360 miles south of the Panama Canal. It is served by the Ferrocarril del Pacifico, a 36-in. gage railway having a total length at the present time of 550 km. and extensions of 35 additional kilometers under construction. Through connections with railways of adjoining departments, a total railway length of 700 km. will be tributary to the port by the end of 1927. It serves a rich agricultural region close to the port and climbs

over mountain ranges by grades up to 3 per cent to reach other agricultural areas farther inland.

The net revenue of the railroad has increased from $6,889 in 1920 when the railroad was operating 233 kilometers to $978,531 for the first month in 1926 with 545 kilometers in operation. In the same period the annual export and import traffic increased from 35,000 metric tons in 1920 to 79,853 tons for the first 8 months in 1926.

On the basis of the net revenue for the first eight months of the past year a total net for the year of about $1,500,000 may be expected. The increased mileage is expected to add materially to the tonnage handled in 1927 and with the improved port facilities it is hoped that ocean freight rates can be reduced.

The port development work will be carried out under the direction of the Ferrocarril del Pacifico of which Dr. Mariano Ospina Perez, minister of public works, is president of the board of direction.

The railroad property is being administered by Gen. Alfredo Vasquez Cobo, general manager, under whose direction it has been extended from 233 km. in 1922 to 545 km. at the end of August, 1926. Engineering and construction are carried on under Dr. Arturo Arcila Uribe, chief engineer. The character of the railroad construction work now in progress is shown in Fig. 2 and Fig. 3.

Contract for the port work has been let to the Raymond Concrete Pile Co., of New York. Robert K. West is manager for the contractor in Colombia and R. A. McMenimen is in charge of field operations.

FIG. 2—A PORTION OF THE RAILWAY LINE IN THE MOUNTAINS

FIG. 3—TYPICAL EARTHWORK ON THE RAILWAY EXTENSION WORK

Salmon Problem Still Unsolved Say Ichthyologists

THE International Pacific Salmon Investigation Federation, which is said to include the "leading fisheries officials of the United States, Dominion of Canada, British Columbia, Washington, Oregon, California and Alaska," at its annual meeting in Seattle Dec. 2, 1926, adopted a resolution condemning "propaganda based on the partial success of an experimental fishway at the Baker River dam." This is the fishway about which an article was published in *Engineering News-Record*, Oct. 21, p. 652. The resolution reads:

"*Whereas*, a constant and nation-wide propaganda has been maintained in newspapers, engineering and technical magazines conveying the impression, based on the partial success of an experimental fishway at the Baker River dam near Concrete, Wash., that a complete solution has been reached of the problem of safeguarding salmon runs jeopardized by the construction of dams; and

Whereas, in the opinion of this federation no solution of this problem has yet been reached that can properly be considered as of general application and

Whereas, in the opinion of this federation the problem connected with each dam is individual and distinct; and

Whereas, much of the work at the Baker River dam so far has been experimental and the results there are not yet conclusive; therefore be it

Resolved that the International Pacific Salmon Investigation Federation at this meeting of Dec. 2, 1926, strongly disapproves the propaganda above mentioned as being unwarranted and misleading; and be it further.

Resolved that copies of this resolution be presented to the newspapers and periodicals and to such officials and others as may be interested."

[The *Engineering News-Record* article stated that a salmon run had been successfully taken over the Baker River dam with the aid of a fishladder embodying the new idea of trapping each pool against the return of salmon downstream (for which credit is given to L. E. Mayhall, superintendent of hatcheries, Washington Department of Fisheries). To have taken 12,000 mature salmon over a dam of this height, as records at the dam show, is certainly notable progress. It is to be hoped that a broad view of the whole problem will be taken by all concerned so that work yet to be done may have full co-operation of all interests.—EDITOR.]

Novel Solution of Bridgeport Dam Spillway Problem

Siphons in Four Corners of Outlet-Works Tower Take Normal Floods—Large Floods Break Through Emergency Spillway Around End of Dam—Observations on Settlement of Earth Fill

By John A. Beemer
Chief Engineer, Montague Irrigation District, Montague, Calif.

AN EARTH dam with exceptional spillway provisions and design and using notable methods of making earth embankment was completed two years ago for the Walker River Irrigation District in western Nevada. This district has two reservoirs. Topaz Lake reservoir on the West Fork of Walker River, with a capacity of 50,000 acre-ft., was constructed in 1921-22; and Bridgeport reservoir, on the East Fork of Walker River, was constructed in 1923-24, with a capacity of 42,000 acre-ft. It is contemplated ulimately to enlarge both existing reservoirs and to build a third reservoir. This article, however, describes only the construction of the Bridgeport dam with the exceptional features of an emergency spillway for the possible one great flood in a century and a working spillway for the maximum flood coming once in two decades and noteworthy because of its siphon type and its combination with the outlet works.

Dam Structure and Foundation—All essential characteristics and dimensions of the dam structure are shown by Figs. 1 to 4. The site is in the mouth of a canyon between a very steep hillside of rhyolite tuff on the east and a morainal deposit with gentler slope on the west. Under the channel, Fig. 3, is a stream deposit of gravel, sand and silt.

In preparing the foundations, the river deposits between the upper and main cutoff trenches under the

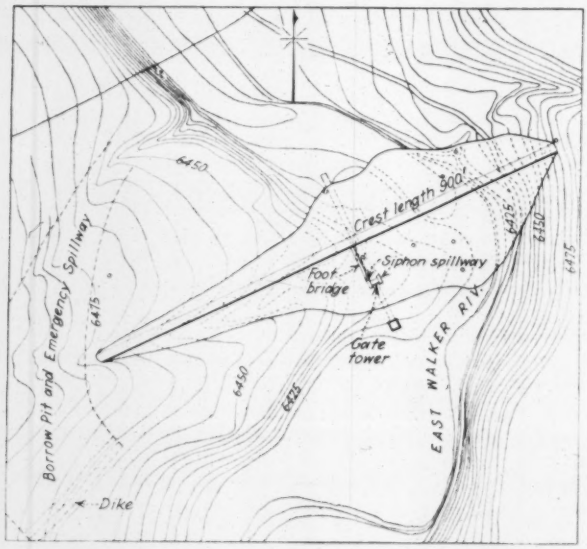


FIG. 1—PLAN OF DAM AND TOPOGRAPHY OF SITE

dam were excavated and the suitable portions were placed in the downstream part of the fill and the rest wasted. The rhyolite tuff had a light loose covering due to weathering and the talus deposit at the base of the hill. The rock became harder with the depth below surface but was nowhere found too hard to excavate with a sharp pick. The loose covering of this abutment was excavated to depths of 3 to 12 ft. and wasted. The morainal material was found to be fairly impervious and well bedded against the ryholite below the river

FIG. 2—MAXIMUM CROSS-SECTION OF DAM

bed and none of this material was removed in the foundation work except in the cutoff trenches. This material is composed of sandy, gravely clay, mixed with boulders. The borrow pit from which the embankment was made is located in this deposit higher up on the west slope. The material made an excellent fill al-

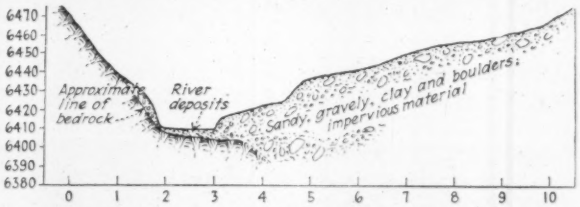


FIG. 3—FOUNDATION SECTION ON AXIS OF DAM

though it was found rather difficult to handle. The sandy, gravely clay compacted well and the boulders made good riprapping on the upper slope and a sufficient fill in the lower toe and downstream slope to insure stability and good drainage.

Spillway Studies and Plans—The greatest flood flow in East Walker River, at the dam site, during the 22 years for which records of the flow were available was estimated to be 1,500 sec.-ft. Bulletin 5 of the California State Department of Public Works, issued January, 1923, shows a flood frequency curve for the East Walker River, from which it is estimated that a flood of about 9,000 sec.-ft. might occur at this dam site once in 100 years.

A permanent overflow spillway around the dam with capacity of 9,000 sec.-ft. or greater would be very expensive due to the unfavorable topography and character of materials, and probably could not have been financed. The adopted plan provides a permanent spillway of 2,100 sec.-ft. consisting of four siphons built into the outlet works, and an emergency spillway of large capacity fashioned out of the borrow pit excavation. A permanent spillway, with sufficient capacity to pass any ordinary flood, was thus provided at low cost by use of the combination structure. An emergency spillway, of very great capacity, was provided at almost no cost as no excavation was done except as required

for the fill, the excavation being kept approximately to the lines and grades as computed and staked.

The borrow pit and emergency channel are located just above and around the west end of the dam, Fig. 1. The grade elevation of the bottom at the intake end is 6,460 which is the flow line elevation of the reservoir. Across this end, which is 250 ft. wide, is a small dike 4½ ft. high. The dike is well constructed with boulder riprapping on the reservoir side. The top of the dike is 5 ft. lower than the dam crest. If a flood occurs which overtaxes the siphon spillways, the small dike in the emergency spillway entrance will be overtopped and partly or wholly washed out. The emergency spillway will then provide a bypass for a large flood, in excess of 10,000 sec.-ft., without danger of overtopping the dam.

Design of Siphon Spillway and Outlet—The siphon spillways and outlet works are combined into a single monolithic structure of relatively thin sections but heavily reinforced. It contains 1,096 cu.yd. of concrete. Four 3x6-ft. siphons are constructed in the corners of the gate tower, the lower legs of the siphons leading to the outlet conduit just below the gate chambers, Fig. 4. This arrangement resulted in a considerable economy in construction and, so far as is known to the writer, has never been employed elsewhere.

The air vents in the siphon hoods are placed at slightly

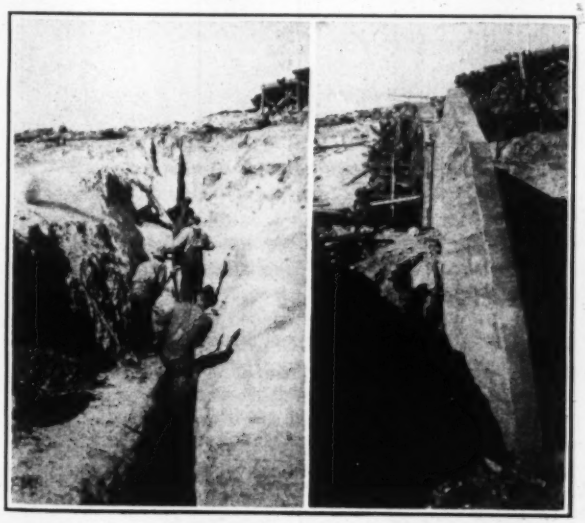


FIG. 5—CUTOFF TRENCH AND CONCRETE WALL.

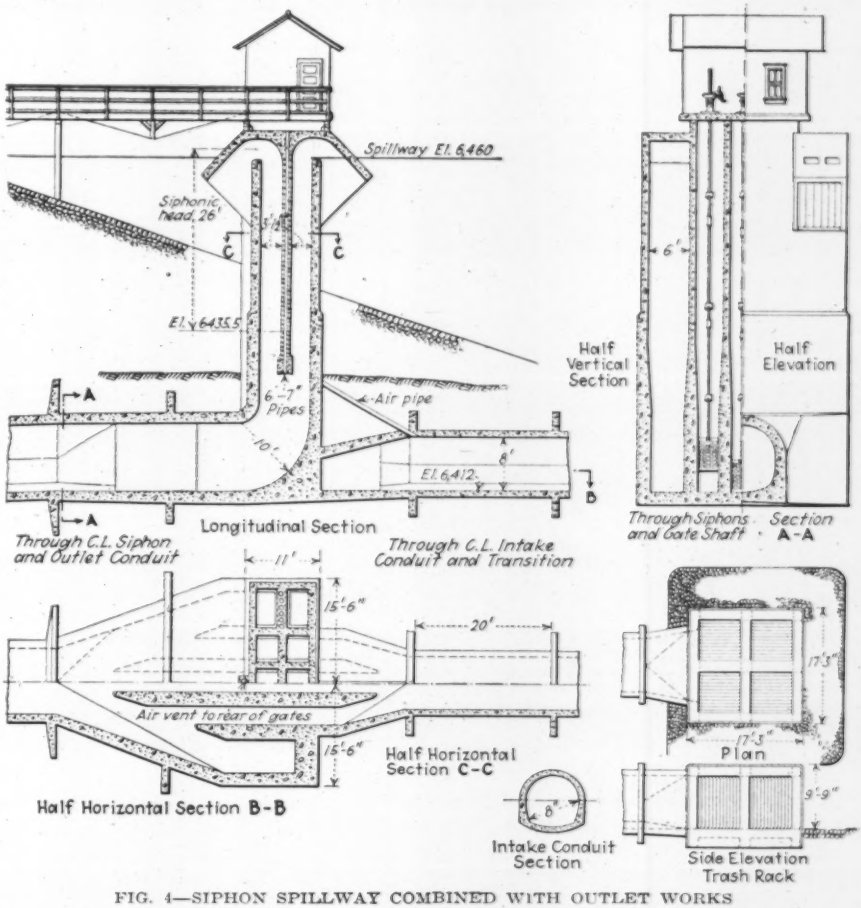


FIG. 4—SIPHON SPILLWAY COMBINED WITH OUTLET WORKS

different elevations so that the siphons will come into action singly and prevent sudden flooding of the river channel below the dam and also limit the amount of such flooding to that actually necessary. In each of the siphons the spillway lip contains a sharp edged metal plate designed to part the overflow from the side wall and cause it to jump across to the middle wall while the depth on the crest is small. At the lower end of the middle wall the section is thickened and plates are fastened here at an angle of 45 deg. to deflect the shallow stream across to the outside wall to effect a seal and insure priming. The deflector projects into the siphon tube a distance of one-eighth the width of the tube.

Test Observations on Model Siphon—Before the siphon design was adopted a small siphon model was made, with all dimensions one-sixth of those used in the design of the large structure. The model was constructed of wood and contained small glass windows through which the action of the flowing water could be watched as the model was tested.

The model operated about as expected. When the water rose on the crest to a shallow depth the thin stream jumped across to the opposite wall, slid down to the deflector and across the lower leg in a fairly compact sheet. When the depth on the crest increased to about 2 in. the siphon would prime, the time required for the complete priming being about 15 seconds. While the priming action was going on there was con-

siderable disturbance and vibration in the structure and the water was mixed with air so that it appeared white and frothy. After priming the stream became nearly clear. A small eddy was observed just below the deflector plate but this deflector appeared to cause very little disturbance after the priming was complete. The deflector plate projected into the waterway a distance of 1 in. or one-eighth the width of the siphon leg, the dimensions of the leg or tube being 6x12 in. the same as the siphon throat.

A number of trials were made with the model to effect priming without the use of the deflector plate but without success. Priming was prompt and certain when the plate was in place but siphon action could not be started with the plate removed, except when the outlet was submerged or covered for an instant. After being primed the siphon action would always continue until sufficient air was admitted through the vents in the hood to break it. In the tests the action was allowed to continue for periods of a few seconds up to 2 hours. The action was not easily broken and required the admittance of considerable air to do it. A short piece of 2-in. rubber hose with one end in the siphon throat and the other held above water, did not supply enough air to break the siphon action. The vents in the hood provided for the purpose had an area of 12 sq.in. equal to one-sixth the area of the siphon throat. The action would be broken with these vents about half open.

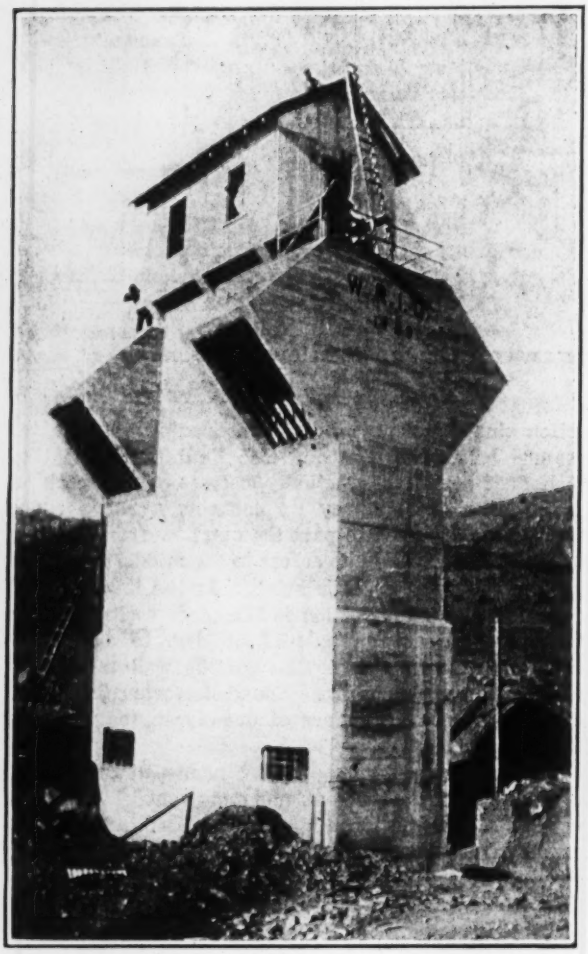


FIG. 6—COMPLETED SIPHON SPILLWAY

The efficiency observed for the model was about 60 per cent. It was realized that in this particular, however, the performance of the model would necessarily differ considerably from that of the larger structure on account of the relatively greater losses in the model due to bends and to the small hydraulic radius. Based upon comparisons of computations for the small and large structure and upon limited information on the discharge of siphons elsewhere obtainable the safe over-all efficiency of the large structure was estimated by the writer to be 72 per cent, giving a capacity for the four siphons of slightly more than 2,100 sec.-ft.

FIG. 7—STEAM SHOVEL IN BORROW PIT

Embankment Construction—Preparing the foundation including cutoff trenches, Fig. 2, followed usual methods and good practice.

The embankment materials were excavated and loaded into 2-cu.yd. dump wagons with a steam shovel, Fig. 7. Two-horse teams were used on the wagons. The average haul was about 1,000 ft. The large boulders were thrown aside by the shovel and left in the pit. Small boulders from about 18 in. in diameter down were dumped on the embankment with the finer materials and were then separated and hauled on stone-boats to the slopes of the dam where they were deposited as riprap or rock fill. The finer materials were leveled, sprinkled and rolled as required.

SETTLEMENT OF ROLLED EMBANKMENT OF BRIDGEPORT DAM, WALKER RIVER IRRIGATION DISTRICT

Depths and Settlements Given in Feet

Station	Depth of Fill	Settlement for First 93 Days	Settlement for Next 250 Days	Total Settlement 343 Days	Total Settlement in 343 Days in per Cent of Depth of Fill
1	33	0.05	0.00	0.05	0.15
2	62	0.18	0.17	0.35	0.57
3	67	0.17	0.19	0.36	0.54
4	48	0.21	0.09	0.30	0.62
5	33	0.11	0.00	0.11	0.33
6	28	0.07	0.00	0.07	0.25

The dumps, Fig. 8, were spaced so that after spreading and compacting the thickness of the successive layers was about 6 in. The materials were sprinkled with hose which could be attached at various points on the movable pipe lines provided for the purpose. A small road grader was used for spreading the materials. Compacting was effected by the travel over the fill and by a Fordson tractor, Fig. 9, which had the rear wheels loaded with concrete. This small tractor roller was very useful throughout all the fill work. It could be turned

in small space and covered portions of the work where compacting was not well done by other travel, particularly along the hillside and near slopes and trenches. It was also equipped with a small scraper in front which could be raised and lowered quickly and which was used to great advantage in backfilling and leveling work in close places, thus saving considerable hand work.

Water for the steam shovel, sprinkling the embankment, concreting and various other uses was piped from a small temporary reservoir located just above

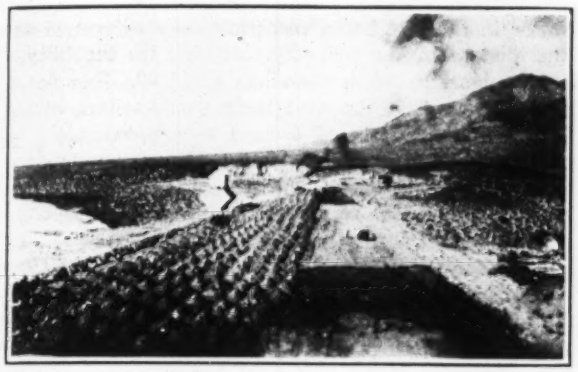


FIG. 8—EARTH DUMPED READY FOR GRADING AND COMPACTING

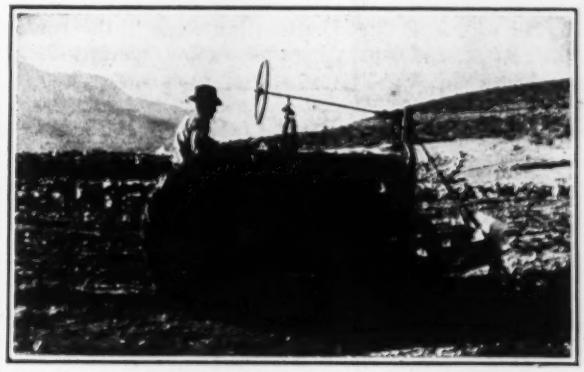


FIG. 9—TRACTOR WITH CONCRETE-FILLED WHEELS FOR COMPACTING AND GRADING

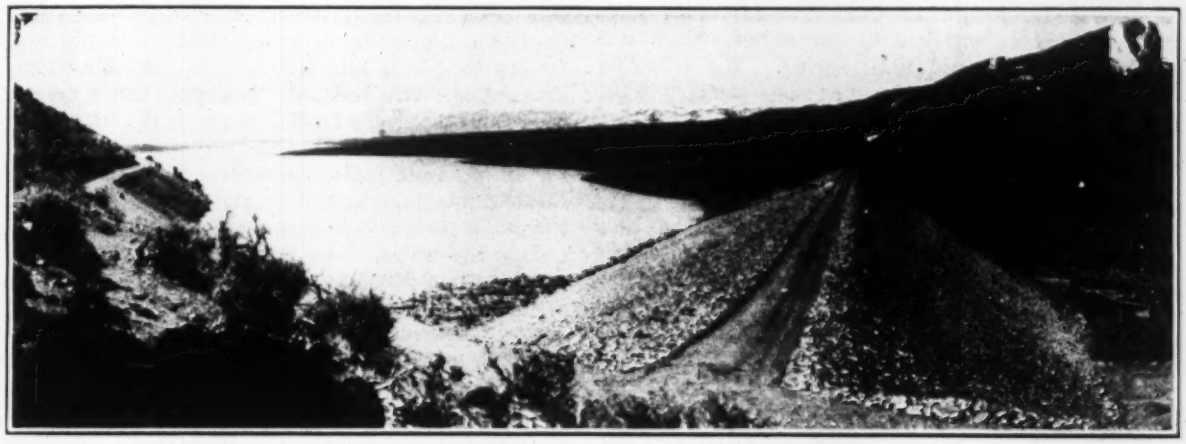


FIG. 10—BRIDGEPORT DAM PRACTICALLY COMPLETED

the borrow pit, the supply being pumped from the river below the dam.

The material in the pit had to be loosened by blasting to enable the shovel to make any fair rate of progress. The "coyote" method, black powder and the electric firing machine, were used in the blasting. Whenever practicable, a large yardage was loosened at a time, five to ten charges being set off at one firing. Lack of space and time, however, usually conflicted with blasting economy.

The embankment fill was placed at an average rate of about 20,000 cu.yd. per month, working one 9-hour shift per day. The shovel capacity was 1 cu.yd. An average of 12 dump wagons were kept in service.

Settlement of Fill—To determine future settlement of the fill steel rods were driven into the embankment along the center line of the crown at even stations. They were corrugated steel reinforcement bars, cut in 4-ft. lengths, and were driven down until the tops were about 3 in. below the surface. Accurate levels were run from a permanent bench mark located near the embankment, on Nov. 1, 1924, just after embankment was finished, then on Feb. 2, 1925, and again on Oct. 3, 1925. During the period for which settlement was determined the depth of water against the embankment ranged from 10 to 40 ft. The results of these observations are given in the accompanying table.

Seepage Observations — The maximum seepage through or under the dam in or near the old river channel has amounted to about one-fourth of a second-foot. About an equal amount has appeared along the base of the west abutment from 100 to 300 ft. below the downstream toe of the dam, in small springs which were first observed in June, 1925, about seven months after the beginning of storage in the reservoir. These appear to be the result of slow percolation through the hill, around or under the west end of the embankment. No seepage has so far been observed below the east abutment nor any percolation along the concrete outlet conduit. On the whole, these losses are small and nothing has been discovered which would indicate danger from this cause.

Some Construction Costs—Accurate costs for the different items of all the construction could not be obtained due to the default of the contractor when the work was about 30 per cent completed, and when, in accordance with the contract, the work was taken over and completed by the district.

The reservoir cost the district in round figures $357,000 or about $8.50 per acre-foot of storage capacity.

Of this $120,000 was paid for lands and rights, leaving $237,000 for construction and overhead. The construction included 4¾ miles of road building around the reservoir, costing about $12,000.

The largest portion of the work taken over by the district was the embankment fill of which 93 per cent remained uncompleted. Accurate costs were kept for the remainder of this item. The cost was 82.8c. per cubic yard, including all labor, materials, repairs, depreciation, overhead and other items properly chargeable to this part of the embankment work. Of this 82.8c. the writer estimated that the blasting work in the borrow pit cost 8c. and separating and placing boulders 24c.

Coagulant Being Used to Reduce Turbidity in New York Water

High Turbidities in Supply Reservoirs Caused by Floods in Late Fall—Satisfactorily Reduced by Alum Treatment

By W. W. Brush

Chief Engineer, Department of Water Supply, New York City

Heavy rainfall and runoff in the areas tributary to the Ashokan reservoir on Nov. 15, 1926, so increased the turbidity of the water drawn from the reservoir that resort was had to coagulation, which will probably be continued until spring. The following notes, which may be considered as supplementary to the letter from the present writer appearing in *Engineering News-Record*, Dec. 23, 1926, p. 1050, describe the conditions leading up to the use of coagulation and summarize the general results that have followed.

The Catskill supply for the city of New York has been in use since early in 1917. Up to February, 1924, this supply was obtained from the Esopus Creek, the water being stored in the Ashokan reservoir, the tributary watershed being 257 sq.mi. and the storage capacity of the reservoir 130,000 m.g. In February, 1924, the Shandaken tunnel was placed in operation, delivering water from the Schoharie Creek, the water being delivered into the tunnel by a small diverting basin holding only a few million gallons. The flood flows passed over the temporary dam.

In July, 1926, the Gilboa dam on Schoharie Creek was completed, forming the 20,000-m.g. Gilboa reservoir. The tributary watershed for the Gilboa reservoir is 314 sq.mi. On Nov. 15 and 16 a very heavy rainfall occurred on both the Schoharie and the Esopus watersheds, the average rainfall for these watersheds being respectively 3.65 and 4.37 in., the maximum recorded rainfall at any gaging station being 7.70 and 6.05 in., respectively. The heaviest rainfall occurred on that portion of the watershed which represents the divide between the Schoharie and Esopus creeks.

There are numerous clay banks in these watersheds, and a large amount of finely divided clay and silt was carried into the streams by the surface flow. The turbidities of the streams undoubtedly exceeded 300, and the flood in the Esopus watershed was the highest recorded in twenty years. The Schoharie reservoir rose 52 ft. in one day and in a week's time the reservoir that had previously been emptied was nearly full, lacking only 5 ft. of reaching the top of the dam. In the Ashokan reservoir the west basin rose in one day 18¾ ft., the maximum flow for one day for each watershed being about the same, slightly above 11,000 m.g.

At this time there was very little water in either basin of the Ashokan revervoir. The west basin, which received the flow of Esopus Creek, and also the water diverted through the Shandaken tunnel, was filled with a highly turbid water, the turbidity averaging probably about 120 with much driftwood and other débris. The draft from this basin was cut off and the water taken from the east basin, which was clear. By Dec. 8 the water in the east basin was practically exhausted and the west basin was full. By this time the turbidity in the west basin had decreased to about 90. Samples of water taken from the west basin would reduce in turbidity in the course of 5 days to approximately 12, and would then persist at this turbidity for many days. In previous flood periods there had been a larger quantity of clear water to mix with the turbid water, and also the turbid water from the Schoharie watershed was not delivered into the Ashokan reservoir, except to a very limited extent.

When the Catskill works were designed, an alum treatment plant was located about three miles above the point where the Catskill water is delivered into the Kensico reservoir, this reservoir having an available capacity in round figures of 30,000 m.g. At first it was hoped that the turbidity would so decrease that at the end of four or five weeks the water would be satisfactory to deliver into the Kensico reservoir without coagulation. This had been the experience in previous flood flows that had occurred during 1917 to 1926.

When it was found that the turbidity would persist for an indefinite period, tests were made to determine the amount of alum that would have to be added to the water to produce a satisfactory coagulation and clarify the water. The laboratory experiments indicated a grain per gallon. This amount of alum would virtually exhaust the alkalinity of the water, and soda ash to the extent of one-half the amount of alum added was recommended to maintain the alkalinity of the water, which is normally about 8, in the Catskill supply. At first the treatment was undertaken with a flow through the aqueduct of 100 m.g.d. or less, and later this flow was increased to 400 m.g.d. It is now over 500 m.g.d.

The alum has formed a satisfactory floc in the water, when used at a rate even lower than one grain per gallon. There is a noticeable difference in the turbidity of the water after the water has passed about 100 ft. from the influx chamber, although there is a zone of very turbid water that flows along the shore opposite the influx chamber and extends for several hundred feet from the chamber. At this time of the year there is virtually a constant vertical motion in the water due to temperature changes, which retards sedimentation. The water reaching the efflux chamber about 3 miles from the influx chamber at Kensico reservoir will show a slight turbidity of between 5 and 8 p.p.m. as compared with a normal turbidity of 2 p.p.m.

From present indications, the treatment with alum will have to be continued for the greater part of the winter and early spring months. The influence of the more turbid water form Schoharie Creek is an important factor in the continuance of a high turbidity in the contents of Ashokan reservoir.

American Road Builders' Association Meets at Chicago

Convention Has Largest Attendance of Recent Years—Long Program Carried Through by Holding Separate Sessions for Engineers and Contractors—25,000 Visit Road Show

HIGHWAY contractors and engineers meeting in Chicago last week at the annual convention of the American Road Builders' Association carried through a long program of addresses and papers without any considerable slacking of interest in any of the nine sessions. Three of these were general sessions for both contractors and engineers, and six were separate sessions, three for contractors and three for engineers. In general, the subjects selected by the program makers were on general administration and management. They brought out rather more than the usual activity of discussion, particularly in the sessions held by the contractors. Extracts from several of the papers are given elsewhere and some others will appear in succeeding issues. Here space is given only to a general résumé of the convention proceedings.

General Sessions—In his opening address, H. G. Shirley, president of the association, bore down hard on the desirability of having control of traffic centered in the highway departments of the states. He called warning that unless highway departments assumed their responsibility in the matter some authority would take the problem in hand and the highway departments would be relegated to subservience in traffic management. Gov. Len Small spoke of road development in Illinois and stated that this year full activity would begin in road building under the $100,000,000 bond issue.

The Road Show at the Coliseum was the largest ever held, with about 25,000 recorded attendance. It is reported on p. 133.

Foreign delegates were given leading place on the program at the general session on the second day. There were papers on Canadian highways by E. A. James of Toronto, on Mexican highways by Andres Ortiz, on Chilean highways by Benjamin Gonzales Cohen and on Cuban highways by Manuel Alberto Coroalles. Speaking of the Mexican highway program, Mr. Ortiz stated:

During 1925, the first year of extensive road building in Mexico, the government spent thirteen and one-half million pesos, which corresponds to about 4.4 per cent of the total federal budget. The Federal Highway Commission of Mexico, created to promote the construction of national roads in the country, bought machinery for approximately three million pesos, being equipped now with machines of various types and sizes which will efficiently build and maintain our roads. All the machinery that is at present used in Mexico is of American make and bought after careful selection of the best manufacturers.

At the closing session T. H. MacDonald gave an illustrated talk on European roads in the countries visited by the American delegates to the International Road Congress; and there were papers by J. T. Ellison on control of payment for pavement quantities, by A. W. Brandt on publishing engineer's estimates and by F. T. Sheets on qualifying bidders. Describing various procedures Mr. Ellison said: "Summing up, we find that the engineer in charge should have absolute authority in regard to quality of the materials used, that an accurate and dependable means of measurement should be provided, and in addition the engineer should have authority to rule off unsatisfactory equipment. This authority when exercised by an engineer of experience and mature judgment will not only insure satisfactory work, but will enable the contractor to do the work at minimum cost."

Stating that advantages and disadvantages of publishing engineers' estimates were so evenly balanced that conclusions were difficult to draw, Mr. Brandt said:

A much more important thing than the publication or non-publication of engineering estimates, in the opinion of the writer, is the proper selection of contractors. Our law should be so drawn that awarding officials can require more than a bond as a proper qualification for the award of a highway contract which may run into many hundreds of thousands of dollars. Officials should have the authority to investigate the contractor from the standpoint of experience, equipment and organization and all bidders should be able to submit with their proposals a complete financial statement showing their net worth in liquid assets. The official should then have the authority to absolutely reject the proposals of all contractors who are not able to meet a certain minimum qualification set up as necessary for not only the proper completion of the contract but for its proper prosecution, in order that it may be finished in the shortest time consistent with good work. He should, moreover, have the authority to award to the lowest bidder who can meet the necessary qualifications and not be obligated to re-advertise because the low bidder is not responsible.

Engineering Sessions—Outstanding in the engineers' program were the papers by T. W. Allen, L. R. Ames, E. F. Kelley and F. T. Sheets from which extracts are given in following pages. Discussing widening versus parallel roads, B. H. Petty in a long paper concluded that, "The majority opinion of highway engineers and officials considers 40 ft. as being the maximum desirable continuous width of pavement for our heavily traveled highways. Where this is not adequate for the traffic, parallel routes (not necessarily within a mile or two of the road) should be developed to handle the excess."

Discussing the economic selection of pavements, H. E. Breed presented the following tabulation:

	5-Year Transient	10-Year Existent 1st 10 Yr	10-Year Existent 2nd 10 Yr	20-Year Persistent
Grading, drainage, etc	$10,000	$10,000		$10,000
Base course		9,000	$4,000	
Surfacing	5,000	6,000	6,000	25,000
Total cost	15,000	25,000		35,000
Average Yearly Charge				
Interest at 4 per cent	600	1,000	800	1,400
Annuity of part only (replacement)	923	1,249	833	839
Annual maintenance	600	300	300	60
	2,123	2,549	1,933	2,299
		1,933		
		4,482		
Average annual cost	2,123	2,141	.....	2,299

Referring to the tabulation, he concluded that then "the average annual cost of the persistent pavement is $176 more than that of the transient, and only $58 greater than that of the existent type, a difference which is more than offset by indirect costs. The annual cost should always be considered more important than the initial cost, and where the annual cost of two types is the same, the preference should always be given to the more durable type, even though it requires greater

initial outlay. This principle firmly established will prevent many uneconomic selections of type."

In a discussion of maintenance problems, organization and methods, W. H. Connell spoke of contract maintenance. Citing instances of its employment he said:

Maintenance repairs are of such an indefinite character that, in the first place, they cannot be definitely specified, in each instance the amount of material to be used becomes a question of judgment that must be exercised by the man delegated to make the specific repairs. Wherever repairs have been made by contract there naturally has been an inclination on the part of the contractor to feel that far more extensive repairs should be made than are necessary and far more material used than is necessary. This is simply human nature.

There is not much discussion today relative to the advisability of making general repairs by contract but there is considerable discussion relative to doing certain classes of resurfacing of stone roads by contract. As long as this work can be done by men employed by the department, trained in this character of work, who also make general repairs, it seems logical that the work should be done by department forces. Due to the flexibility of the organization the resurfacing can be done by department forces more economically than by contract if the work is controlled by an up-to-date well-trained highway engineering organization. To do this work by contract it is necessary to make surveys, prepare plans, advertise the work, award contracts, put on an inspector, give the contractor a profit, all of which is eliminated when the work is done by department forces.

A long paper by F. H. Eno reviewing subsoil investigations besides tracing the work accomplished gave the following as important further needs:

(1) A more intelligent investigation of the dangers in making cuts for the purpose of balancing cut and fill. The danger is in cutting through good soil and establishing the subgrade on the worst soil to be found in that locality.

(2) More care in location throughout bad soil areas. Such, for instance, as the location of the road where a cut has to be made near the foot of a talus slope where landslides will pretty surely happen when the existing stability has been upset.

(3) Better record of subsoil conditions, construction details, and maintenance required on a considerable mileage of paved roads through both good and bad soil areas in order to evaluate the actual costs of bad soils.

(4) The need of having a trained soil engineer attached to every state highway department to study soil conditions throughout the state and advise upon every road constructed.

(5) The evolving of a simple bearing value test for subgrade soils.

(6) The discovery of some simple method of controlling the moisture content of heavy clay soils for at least two feet beneath the pavement.

Construction Sessions—With general papers on constructor and contractor defined and on day labor by J. T. Ellison and R. C. Marshall of the Associated General Contractors, the construction sessions took up specific problems of highway contracting. In an emphatic paper on estimating and cost accounting J. M. Dallam concluded with:

The method used is less important than the completeness and comprehensiveness of its data. Every system is founded on frequent and detailed reports from the field, and the more exact and comprehensive these are the more perfectly the cost accounting force will be able to figure in detail the exact cost of just what is being done.

The field should make its report at the close of every day's work. It should tell exactly the labor cost of that day on each item making up each unit as the estimator figured it. In the matter of excavation for example, the report should give the most careful estimate possible of the yardage of earth moved, and tell between what stations this work was done. It should tell the number of hours of labor, hauling, etc., on clearing, loading and every other constituent operation of excavation.

To this the cost accountant in the office can add the pro rata of overhead, etc., and by careful figuring tell from day to day whether the job is making or losing on each operation, whether there is an overrun of material, and all the other obscure features of the work that need careful checking from time to time in order that the possibility of loss may be reduced to the minimum.

The value of engineering representation in contracting organizations was epitomized by W. M. Willmore:

We all desire the co-operation of the engineering personnel of the political subdivision under whose jurisdiction the contractor is doing his work, and more particularly the project and resident engineers on state work. The engineer in the contractor's organization can well be the means to the end, if he be competent and tactful.

Not infrequently the project engineer is pressed for time in looking after the many engineering details on his project, and if a spirit of co-operation has been cultivated by the contractor's engineer, he can be of considerable assistance to the project engineer, thereby enhancing somewhat the position of the contractor, and in no wise impairing the efficiency of the engineer, or engineers, on the job. A check-up on stakes, and other engineering details, by the contractor's engineer avoids errors, and, not infrequently, unnecessary work, and through the proper co-operation, his assistance to the engineer in charge will very often aid the contractor in the prompt prosecution of his work by seeing to it that all engineering details are considerably ahead of the operations on the job.

Summarizing practice in the state purchase of construction materials, A. F. Johnson described the trend of contracting opinion as follows:

The advent of any state into purchasing of material is of recent date, commencing about 1921, and was brought on by the tremendous increase in demand for hard-surfaced roads in 1920. This necessitated a big increase in material needed and the existing producers in many cases were not equipped to take care of this large demand for their product. An unusual shipping situation also developed in 1920 and the construction program was slowed down.

The two main reasons that induced some states to purchase material at that time were: (1) To insure sufficient supply of material, (2) to reduce the cost of such material. These same reasons are today the governing factors when a state considers the purchase of material, especially cement, for its highway work. An argument has been advanced for states purchasing cement that they would then get a better quality of cement and be assured that the right amount of cement was used. With the inspection and supervision that all states have on road work, there can be no question of quality or quantity, whoever furnishes it.

A responsible contractor prefers to purchase and control all materials entering into his construction work. He serves the purpose of furnishing: (1) Equipment and organization, (2) necessary finances, (3) purchasing power for material and labor, (4) responsibility for the prosecution and completion of the work involved. For any and all of these, he will function better and more economically than any other agency. A state purchasing material does not avail itself of the purchasing power of the contractor and tends to destroy his initiative and this without any apparent gain. State purchasing means government in business.

Election of Officers—Charles M. Babcock, chairman of the Minnesota State Highway Commission, was elected president of the association to take office in May. He will succeed Henry G. Shirley, chairman of the Virginia State Highway Commission as chief executive. The vice-presidents are: Sam Hill, Honorary Life President of Washington Good Roads Association; S. F. Beatty, president, Austin-Western Road Machinery Co., W. A. Van Duser, deputy engineering executive, Pennsylvania Department of Highways; S. T. Henry, director, Pan-American Confederation for Highway Education.

James H. MacDonald, New Haven, Conn., was re-elected treasurer of the association.

Road Builders Review Design and Maintenance Technique

In a Program Largely of General Topics Discussions on Types, Design, Research, Contracts and Construction Uphold Technical Standing of Road Engineering

A cross-section of road design and construction activities is afforded by the group of extracts which follow from the papers read at the convention last week in Chicago of the American Road Builders Association. In the review of the convention proceedings the subjects and brief summaries of the other papers and addresses are given. The list is a long one and in these extracts and summaries only those parts which stand out are given; the correlative data and argument have to be awaited until the complete papers are published in the rather large volume of the association proceedings.

Questionnaires Aid Selection of Contractors

By Frank T. Sheets
State Highway Engineer, Springfield, Ill.

THE protection of the public from the irresponsible contractor has become a problem of great importance. A survey of public-works contracts executed throughout this country during the past ten years will show a long procession of disastrous failures of contractors. These failures have brought sorrow and suffering to the families and friends of the contractors themselves; they have cost the public millions of dollars in inconvenience and delay; and they have caused the bonding companies who have furnished bonds to suffer losses which have been automatically passed on to the entire construction industry.

In the Illinois Department of Public Works and Buildings, Division of Highways, we have faced this problem and have tried to meet it. Our laws require that our contracts be let to the lowest responsible bidder. We have realized fully that no arbitrary determination of the responsibility of a bidder could be made without suspicion of our motives. Therefore, some years ago we adopted a form of financial statement and experience and equipment questionnaire which we required each bidder to submit with his proposal for our consideration. We established, as a result of our own judgment and the judgment of a large number of reliable contractors, the minimum financial qualifications required for the execution of contracts of various sizes; we determined from years of experience the minimum requirements of equipment for various sizes of contracts; we analyzed carefully the prearranged plans of the contractor for handling every project; and with all these data for our guidance we have determined the responsibility of our bidders. Sometimes our judgment has erred, and an apparently responsible bidder has failed during the test of construction, but considering the fact that we have carried on over $150,000,000 worth of road contracts during the past few years since adopting this policy, the number of failures is gratifyingly small. We are still following this practice, and when we determine that a bidder is irresponsible, we write him a letter rejecting his bid and include in that letter a complete recitation of the facts upon which this judgment is based—these facts being taken from his sworn statement. We are willing to publish this letter to the world in case our motives are questioned or we are charged with favoritism, but we have not had to do so.

In many instances when we have rejected a bid, we have suggested to the bidder that although his qualifications were not sufficient to justify awarding the specific contract in question, further bids on smaller and less hazardous work would be welcome, and we have been pleased to see many such contractors develop to the point where they can now tackle most any project we submit.

The questionnaire which we are now using is the standard adopted by the American Association of State Highway Officials and embodies practically all of the features of our original questionnaire. The development of this questionnaire by the joint committees of public officials, contractors, bond writers, and other members of the highway industry has been a distinct contribution to the construction industry and I commend it most heartily for use by every public official. We have absolutely proved its value and would not be without it. It is interesting to note that in the awarding of the above mentioned large volume of contracts by our department not a single suspicion of favoritism nor charge of wrong motive has arisen.

It is only fair to say, however, that sometimes the use of this questionnaire has caused us embarrassment in that we were forced to battle away at this problem alone when the course of least resistance would have been much more pleasant. Many times when the questionnaires submitted by bidders have shown them to be absolutely unqualified for the work they were seeking, we have had reputable surety companies state their willingness to write surety bonds for the bidders in question, and in some instances these companies have urged us to make such an award. It seems inconceivable that a bonding company would be willing to gamble its money on an irresponsible bidder unless the irresponsibility is figured into their mortality rates; and if this is true, it is an unhealthy condition which is unfair to the responsible bidder.

* * *

Highway Contract Control and Engineering Service

By L. R. Ames
Acting State Highway Engineer, Raleigh, N. C.

WE HAVE found that the most important time to start contract control is *before* the award of the contract. Before awarding a contract, we require a financial statement and an experience questionnaire to be filled out. These statements are carefully investigated and never intentionally is a contract awarded to an irresponsible bidder.

Our contracts read that "working days shall start twenty days after the date the contract is mailed for execution;" this clause has settled many arguments regarding the beginning of the working time of a contract. We allow contractors to bid on the number of working days to complete the project; and in the compilation of bids these working days are figured on a basis of $20 per day, which approximates the cost of engineering. If the contractor overruns his working time agreed upon in the contract or within such extra time as may have been, by formal extensions, allowed for delays, a deduction of an amount equal to the actual cost incurred by the state highway commission is made for each day that such contract remains uncompleted.

The successful administration of any construction contract is dependent to a large degree upon the character of the specifications. If specifications are in any way

uncertain, allowing the engineers and contractors wide freedom in their interpretation, there is always a feeling of suspicion on the part of the contractor that he is not getting a square deal.

One of the most important services connected with any large construction program is competent and intelligent inspection. This can best be handled and supervised by central office control, with construction engineers operating out of the central office and making periodical visits to each project. These men correlate and standardize all work under way in such a manner that the same type of construction and methods may prevail throughout the state. This type of service is especially important on account of the fact that whenever any state inaugurates a large road building program, contractors are attracted from all parts of the country which results in many conflicting ideas regarding methods and workmanship.

One very important service that the engineer should render, and one that is too often overlooked, is in laying out the work well in advance of the contractor's operations. No matter how capable the contractor or how favorable the conditions, an engineer can delay operations by not having the work laid out well in advance.

It is very essential that work should be uniform and the requirements the same in each district or division. In practice, this objective is very difficult to obtain. However, a contractor cannot bid on a project intelligently unless he knows in advance the requirements, and it should not be necessary for him to bid higher in one district than another on account of uncertainties of these requirements. This is a very strong reason for central office control.

* * *

Construction Plant Has Too Low Load Factor

By J. L. Harrison
Highway Engineer, Bureau of Public Roads, Washington, D. C.

LOAD factor is not a term much used in highway engineering. Electrical engineers all understand it because they have become accustomed to the idea that in power distribution the possibility of profitable operation is vitally affected by the amount of load carried and its distribution throughout the day. So they invented the term load factor. If a power plant is working at a load factor of 50 that means that it is producing and distributing 50 per cent of its rated output capacity. The load factor, then, is a measure on a percentage basis, of the use which is being made of the equipment.

Now in electrical power distribution a high load factor commonly spells good profit and a low load factor a loss, because operating costs are determined by the nature of the equipment rather than by the amount this equipment is producing. A 100,000-kw. power plant needs no more attention when operating at a load factor of 70 than when operating at a load factor of 20. There is some difference in fuel consumption, but all other operating costs remain pretty nearly constant. It is exactly the same in highway construction. When a contractor's selection of equipment is good a high load factor can be maintained; if poor, the load factor unavoidably will be low. Poor management in the field may reduce the load factor, but good management cannot improve it above the limit of the controlling equipment. A high load factor spells profit while a low load factor usually means loss.

Low load factor is common in concrete paving. It is not unusual to find that a paving job is operating under an equipment set-up which limits the load factor to 50 or 60 on all but the shortest hauls. In paving work the commonest cause of low load factor is inadequate equipment. Low load factor in grading work commonly is the result of either or both of two causes—poor design and poor job planning.

The engineer who introduces into his grading plans occasional elements of long haul yardage creates a condition which is peculiarly effective in lowering the load factor. No contractor is equipped to maintain a high load factor against both long haul and short haul. Inevitably he must either sacrifice load factor on his shovel or on his hauling equipment, or work out an arrangement which sacrifices something on both. The point it is desired to emphasize is that, particularly in grading work, the design itself may set a limit on the load factor that can be secured, and that design in this field is today of a relatively low order. Contractors would avoid many losses if they would study the load factor imposed by the design as affecting production with whatever outfit they will use if the work is secured before bids are entered, for in this way the jobs so poorly designed that the cost must be high can be avoided.

But while it is admitted that plans, particularly for grading work, are drawn with little or no consideration of the load factor, it is quite as true that contractors, speaking generally, make no adequate appraisal of this condition either before bidding or after the award, and so fail often to get all the profit there is to be had whether the job is well designed or is poorly designed. This most obvious cause is unbalanced, unco-ordinated equipment.

* * *

Investigation of Thin Paving Brick

By E. F. Kelley
Chief Engineer of Tests, Bureau of Public Roads, Washington, D. C.

THE behavior of the test sections was compared largely on the basis of the number of brick broken during the progress of the test. It should be understood, however, that while traverse breakage was taken as a criterion of service, this breakage did not materially affect the actual serviceability of the test sections (Fig. 2). The results of the accelerated test are shown graphically in Fig. 1.

The most important conclusion derived from this investi-

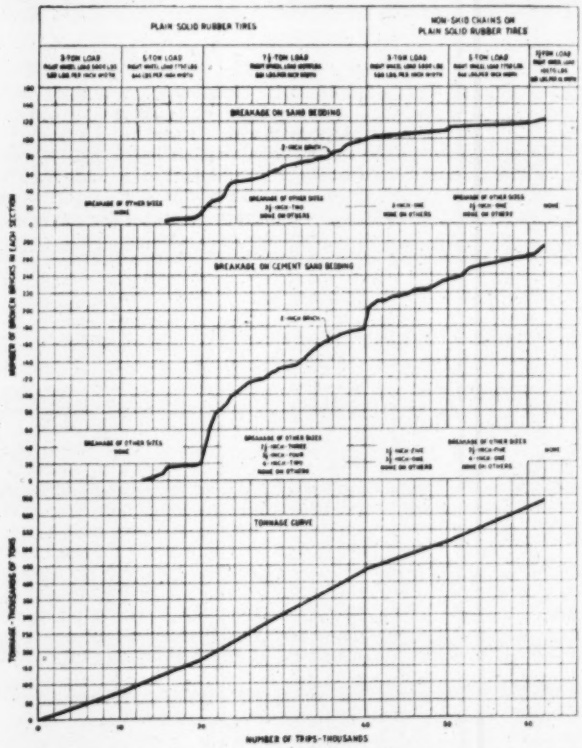

PLAIN SOLID RUBBER TIRES
NON-SKID CHAINS ON PLAIN SOLID RUBBER TIRES
BREAKAGE ON SAND BEDDING
BREAKAGE ON CEMENT SAND BEDDING
TONNAGE CURVE
NUMBER OF TRIPS-THOUSANDS

FIG. 1—RESULTS OF THE ACCELERATED TRAFFIC TEST ON BRICK PAVEMENTS

gation is that 2½-in. brick of the quality used in the tests, when supported by an adequate base, are satisfactory for pavements carrying heavy traffic. Also that 2-in brick of similar quality and properly supported are adequate for pavements carrying the lighter types of traffic.

The resistance to breakage of the 2½-in. brick was remarkable and, for the particular conditions of this test, was only slightly less than that of the thicker brick. In the 30-in. wheel strips which carried the traffic loads, only fifteen bricks were broken in the sections of 2½-in. brick.

One brick was broken in the 3-in. sections, six in the 3½-in. sections, three in the 4-in. and 398 in the 2-in. section.

The Bates Road test in Illinois and previous investigations by the Bureau of Public Roads have shown that bituminous-filled brick tops cannot be expected to add materially to the beam strengths of pavement bases. This seems obvious, since a flexible wearing surface which has no bond with the base can scarcely be expected to add to its structural strength. Therefore, it has been concluded that the base should be as heavy for one thickness of brick as for another. The field survey has shown that, in practice, changes in base thickness are seldom made to compensate for changes in brick thickness.

The accelerated traffic test was designed to test the brick as a wearing surface and the foundation was more than adequate for the loads to which it was subjected. It is

FIG. 2—BRICK BREAKAGE ON SAND-CEMENT BED
Close-up view of 2-in. brick showing the condition after completion of the plain-solid-tired traffic. Broken brick are marked with white painted symbols.

emphasized that, if failures of brick pavements are to be avoided, the base course must be designed to carry the loads. The base must be stable in itself regardless of the thickness of the brick surface.

The accelerated test showed very definitely that the plain-sand bedding course is superior to the cement-sand bedding. In the 2-in. brick sections the breakage which occurred on the plain-sand bed was less than one-half that which occurred on the cement-sand bed.

Cobbling or rounding of the edges of individual brick was shown to be due almost entirely to the use of non-skid tire chains. The amount of cobbling under chain-tired traffic was found to be directly affected by the distance between bricks, wide joints causing marked increase in the rounding of the edges. From this it is concluded that the spacing between bricks should be the minimum consistent with proper penetration of the bituminous filler.

As a result of the field survey it may be pointed out that the maintenance of a smooth-riding brick surface is largely dependent on a bedding course of uniform thickness and uniform compaction. The adverse effect of using too thick a bedding course or one of variable thickness is marked. The bedding course should not greatly exceed ¾ in. in thickness and its uniformity depends on the degree of accuracy with which the base course is finished. Another construction detail which deserves attention is the application of the asphalt filler. There is a general tendency to use an excessive amount of filler and this results in a rough pavement surface. It is important that the filler used be adapted to the climatic conditions and that only enough be used to fill the joints. The advantages of smooth pavement in improving riding qualities and in reducing destructive impact effects justify careful control of these construction features.

This investigation has yielded results which indicate the possibility of very appreciable reductions in the cost of brick pavement construction. By the use of thinner brick very large aggregate savings may be effected and the value of the investigation as it may influence economy of construction is immediately apparent. For this reason the tests have had a particular interest since the benefits derived from them may be computed rather accurately in terms of money value. This is a characteristic not too common to research projects.

The accelerated test demonstrated the value of thin brick as a pavement surface but it did not demonstrate that the thin brick is necessarily the equivalent of the thicker brick commonly considered as standard in pavement construction. The use of thinner brick undoubtedly reduces the factor of safety and for this reason the maintenance of a uniformly high standard of quality is essential if advantage is to be taken of the indicated savings.

Several types of base have been observed to render satisfactory service under rather severe traffic conditions, but in this connection it should again be emphasized that the first requisite of any brick pavement is a foundation which is stable, no matter what its type may be.

* * *

Selection and Care of Highway Maintenance Equipment

By W. H. Root
Maintenance Engineer, Ames, Iowa

WHEN new machinery is needed, make a careful study of the future development of the road upon which the equipment is to be used. Otherwise it may fit in only for a year or two. Also be sure that types selected will fit in with other equipment already on hand in that particular maintenance unit; co-operation of equipment as well as co-operation of men is essential.

In choosing an equipment type, the most important consideration is that the equipment selected must do the job that you have for it, and that it must continue to do this job over a reasonable period of years. The type must be proven. A machine has not established its right to serious consideration until it has been operated under typical conditions for a year or more. Do not construe from this that the purchase of new designs is undesirable. Every state should buy new developments of machinery adapted to their work, but such purchases should be limited to a few experimental outfits until the machine has proven itself. Don't buy the lowest priced machine, but be sure that the machine bought is not over-priced. Some machines are priced for trade-ins.

Look into the matter of parts, prices and service. Any machine will require new parts occasionally, and these should be furnished at a reasonable price, and they must be furnished promptly. Delays due to poor service on repair parts are expensive. Also look to the power of any equipment. Horsepower ratings are not always reliable and an underpowered machine is a constant expense and irritation. The fuel cost is another item which should be investigated. It is not enough that a machine do the work required of it, but it should do this work at an economical operating cost. Then last but not least, in determining the dealer from whom you will make your purchase, keep in mind that it is always desirable to deal with a well-established firm. Our junk yards are full of useless orphaned machines. The amount of money represented by this junk is a tremendous sum, and is one of the few public road expenditures which is open to criticism.

Road maintenance equipment should be kept painted. This preserves it against the weather, and has a good psychological effect on the operator and upon the public. An operator is less apt to abuse a well-painted machine than he is a rusty weather-beaten one. Also the public will judge the department somewhat by the appearance of its equipment.

All maintenance machinery should be gone over every few days and loose nuts, joints and bearings made tight. Rainy days when the equipment cannot be operated are ideal times for this kind of work. As to the housing of equipment, most machines should be stored inside in order

to protect them from the elements and from the light-fingered public.

Without doubt, the most important consideration in the care of maintenance equipment is lubrication. Any modern road equipment requires some sort of lubrication, and on some of the more complicated types an hour of greasing and oiling each morning is a necessity.

* * *

Generous Associates of Irresponsible Contractors

By Frank T. Sheets

State Highway Engineer, Springfield, Ill.

CONSISTENT securing of bid bonds by irresponsible bidders led Illinois instead to require that certified checks amounting to 10 per cent of the bid be submitted with all proposals. We were somewhat dumbfounded when we were informed reliably that representatives of surety companies had engaged in the practice of securing certified checks for bidders. Obviously any bidder who cannot raise enough funds to secure a certified check requires sympathy.

It has also been a revelation to us how liberal the banking element of our citizenship has been in dealing with the irresponsible bidder. In some of our most questionable cases, banks have been willing to state that they were ready to extend a liberal line of credit to the bidder.

How marvelous it is also that manufacturers of equipment and producers of material seem quite willing to extend the same business courtesy and line of credit to the "would be" contractor that they do to a firm with millions of dollars of successfully completed work behind it and plenty of cash in the bank. The machinery companies have indeed been most sympathetic and brotherly. I know of one instance where the machinery was delivered on the job on a time payment basis. The contractor then went to the bank and borrowed money with which to run the job and put up the machinery as collateral to secure the funds. For ingenuity in financing, this is unexcelled.

Enough for the activities of the *irresponsible* contractor and his *generous* associates. The responsible contractor is equally guilty in many instances. He goes right ahead buying his surety bonds, buying his machinery, and buying his equipment from the very parties who contribute to his unfair competition and then consoles himself by attending his annual contractors' meeting and singing a long lament about the bad conditions surrounding the contracting business. He comes to the desk of the public official with a complaint about the irresponsible bidder. Why fuss at public officials about the low prices at which public work may be let when the most responsible men in the contracting business repeatedly establish such prices? Either the prices are right and the lament is pure propaganda, or the contracting industry needs to clean its own house.

* * *

Design to Save Money by Reducing Haul

By T. Warren Allen

Chief, Division of Control, Bureau of Public Roads, Washington, D. C.

THE designing engineer should keep all of the haul within such bounds that the ordinary contractor using a reasonable equipment set-up can maintain a high rate of production. It is only in this way that he can do the work at a reasonable cost. He cannot work economically if the engineer has destroyed the possibility of his maintaining a high operating efficiency by producing a design that does not fit in with existing equipment set-ups and current construction methods.

The careful scrutiny of a considerable number of plans has developed the impression that more thought is now given to whether a balance between cut and fill is secured than to whether the haul established will make the maintenance of a high average in production possible, actual construction conditions as they really are being considered.

A series of alternate long hauls followed by short hauls is destructive of economy in construction. On the short hauls, the teams work at less than full capacity, and on the long hauls there are not enough teams. This is just as true for truck hauls as for team haul. Sometimes merely shifting the balance points in the cuts so that haul in both directions from the cuts is equal will convert a very poor design into a reasonably good design, at least so far as the actual cost of doing the work is concerned. Sometimes a grade must be raised, sometimes lowered, or the gradient may have to be adjusted.

By the proper use of such devices it is possible almost entirely to avoid hauls of over 1,000 ft. and to keep the great bulk of the hauling within 700 ft. Where this is done in the original design, the contractor can maintain a high rate of production with an ordinary outfit and the practical result is grading work at a reasonable cost.

* * *

Cutting, Mixing and Curing Time on Concrete Road Work

By T. Warren Allen

Chief, Division of Control, Bureau of Public Roads, Washington, D. C.

SOME engineers specify 1½ minutes for mixing time of concrete, while others specify 1 minute, but a considerable number of field tests indicate that with the better designed mixers and adequate control over materials and water content, ¾ minute of mixing will give a concrete of so nearly the same strength as 1 minute or 1½ minutes that the extra cost of the longer mixing time does not seem warranted.

Cutting the mixing time by this amount and keeping the mixer fully occupied are very important items in a cost reduction program. This may be more definitely expressed by stating that the maximum number of batches of concrete that may be turned out per hour with a mixing time of 1½ minutes is 34, for 1 minute 48, and for ¾ minute 63, and that for a full working day of 10 hours the cost of paving is increased about $400 per mile of pavement laid for each ¼ minute added to the mixing time. Unless recently changed, nine states require a 1½-minute mix, six a 1¼-minute mix, and thirty-three a 1-minute mix.

Also, there is the time specified for curing. With adequate control, this time—except at the beginning and at the end of the construction season—may be cut at least to 14 days. Eight states now require 30 days before the pavement may be opened to traffic, one state 28 days, twenty-nine states 21 days; four require 20 days, one 18 days, three 14 days, and two 13 days.

* * *

Checking Up Road Subgrade for Payment

By J. T. Ellison

State Highway Engineer, St. Paul, Minn.

FINE grading in Minnesota includes all of the earth moved in the area to be occupied by the slab together with a strip 1 ft. in width on each side of the slab.

The amount of this item is determined by carefully cross-sectioning the subgrade and then calculating the amount of excavation or fill required to bring the subgrade to the desired elevation. This item is paid for in both excavation and fill, so that if the contractor cuts down a high point and uses the earth to fill a sag he is paid twice for all the earth so taken out and moved. It is presumed that by this method the approximate subgrade elevation is obtained but to insure greater accuracy a heavy templet carried by the forms and drawn by the mixer is required. If properly used this will insure an accurate subgrade.

The earth shoulders are not a part of the pavement contract, but are awarded on a separate contract from specified borrow pits at a unit price for loading and unit price per yard mile for hauling. These prices also include all the labor and machinery required for spreading the shoulder material and bringing it up to line and grade.

Our pavement slab is let for the unit price per square yard, this price to include the furnishing of all material specified, except cement which is furnished by the state. The matter of a payment for this item is therefore comparatively simple and seldom causes argument.

Structural and Hydraulic Features of Outfall Sewer

North Outfall Sewer for Los Angeles, Calif., Built of Monolithic Concrete, with Vitrified Clay Lining

By W. H. Pinkham
Office Engineer, North Outfall Sewer Division, Los Angeles, Calif.

THE design and construction of the North outfall sewer for the city of Los Angeles has involved a study of an adaptability of various types of sewer used elsewhere, and has led to the adoption and use of a somewhat original type of semi-elliptical sewer for sizes in which massive construction is economical. The objectives in this study have been a type of sewer that could be easily laid with unskilled labor and would have adequate strength to meet analytically the variety of backfill loadings that arise in diversified locations; efficient hydraulic properties; and proper and practical resistance to the attack of strong sewage gases prevalent in the local separate sanitary sewers.

The proportional dimensions of this standard, shown and explained in Fig. 1, are absolute with the one exception of the equivalent radius of the parabolic invert. For sewer sizes apt to be considered, a table of these dimensions has been in use, the channel depth being taken as the size, and the sizes varying by 3 in. upward from 24 in. Tabulations are also used showing quantities of all materials required, the channel area, perimeter and hydraulic radius, the principal dimensions of the shell, and the total displacement of the sewer. The tabulations are useful to bidders, and in laying out forms for construction.

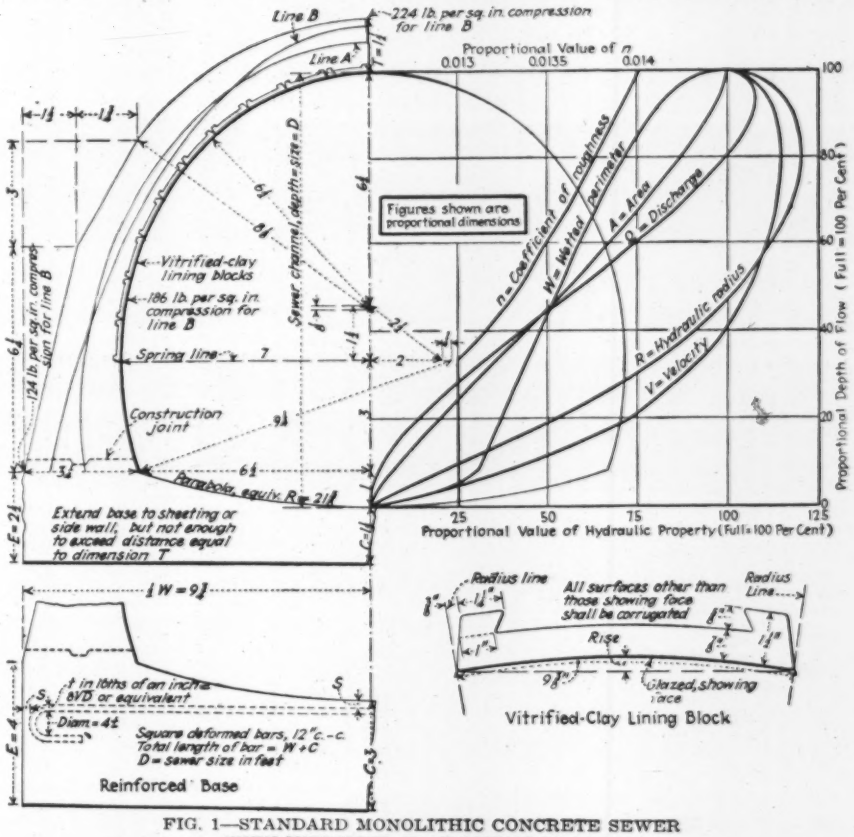

Line B
224 lb. per sq. in. compression for line B
Line A
Proportional Value of n
0.013
0.0135
0.014
Figures shown are proportional dimensions
n = Coefficient of roughness
W = Wetted perimeter
A = Area
R = Discharge
R = Hydraulic radius
V = Velocity
Vitrified-clay lining blocks
186 lb. per sq. in. compression for line B
124 lb. per sq. in. compression for line B
Sewer channel, depth = size = D
Spring line
Construction joint
Parabola, equiv. R = 2 1/2
Extend base to sheeting or side wall, but not enough to exceed distance equal to dimension T
Proportional Depth of Flow (Full = 100 Per Cent)
Proportional Value of Hydraulic Property (Full = 100 Per Cent)
Reinforced Base
t in 16ths of an inch = B.V.D. or equivalent
Square deformed bars, 12" c.-c.
Total length of bar = W + C
D = Sewer size in feet
Radius line
All surfaces other than those showing face shall be corrugated
Rise
Glazed, showing face
Vitrified-Clay Lining Block

FIG. 1—STANDARD MONOLITHIC CONCRETE SEWER WITH VITRIFIED CLAY LINING BLOCKS

Channel area (A) in sq.ft. (full) = (sewer depth in ft.) × 0.958192.
Wetted Perimeter (W) in ft. (full) = (sewer depth in ft.) × 3.579235.
Hydraulic Radius (R) in ft. (full) = (sewer depth in ft.) × 0.267709.
Dimensions of semi-elliptical sewers expressed in inches may be obtained for any depth by multiplying the proportional dimensions shown hereon by channel depth in feet.
The cover "s" shall in all cases be 1½ in.
The cross-section area of vitrified clay lining block is 0.066 sq.ft.

In determining the size of sewer to use, a Kutter's diagram for circular pipes flowing full with $n = 0.014$ has been used. A circular sewer was selected the diameter of which is equal to four times the hydraulic radius of the semi-elliptical sewer under investigation. The velocity determined is multiplied by the area of the semi-elliptical sewer for the discharge. As the sewer sizes vary by 3 in., slide-rule computations have been sufficiently accurate. This shape provides the same full discharge as a square cross-section of the same channel depth.

By reference to the proportional hydraulic properties shown in Fig. 1 it will be noted that, for a discharge of ⅒, the velocity is ⅔. In general the initial flow in the sewers has been assumed at ⅒ the ultimate and in order to provide an initial velocity of 2 ft. per sec. the sewers have in general been given a slope that would produce at least a velocity of 3 ft. per sec., flowing full.

The prime assumption in the many analyses made of the structural properties of various shapes of sewer has been that a uniform and compact backfill would be made, such being the specific requirement of current specifications. In Fig. 1, lines *A* and *B* are the two extreme resultant stresses determined by common elastic theory of arch analysis applied for this illustration to an 8-ft. sewer. The backfill material has been considered as weighing 100 lb. per cu.ft. Line *A* is for a backfill material having an angle of repose of 15 deg.; and line *B* is for backfill material having an angle of repose of 45 deg. (the critical assumption), and both are for depth of backfill over top of sewer of 20 ft. The resultant stresses of a backfill material having an angle of repose of 30 deg. both for backfill depth of 10 ft. and 40 ft. lie approximately midway between the two lines shown and are considered to represent the condition more commonly encountered. The extreme assumptions used for illustration indicate the safety with which adequate structural resistance to such extremes is provided in this type of sewer.

It is of course possible for the designer to adopt different types of sewers for different conditions of construction, and this is sometimes obligatory. However,

such diversity of design results in an expense for new designs and extra expense for contractor's equipment. The designer never knows exactly in advance what extremes will be encountered during the construction nor what emergencies might arise. The adoption of this single standard has greatly facilitated production in the drafting room and it is used with the assurance that it will meet all requirements of strength with certain modifications hereinafter mentioned.

FIG. 2—BUILDING THE LOS ANGELES NORTH OUTFALL SEWER

In foreground, vitrified clay lining and part of form for reinforced-concrete side and top in place. At middle, pouring concrete. In background, a section completed and forms removed.

It has been determined that the total load on the sewer is 162 $(DH + D^2)$ lb., H being the height in feet of backfill over top of sewer with earth weighing 100 lb. per cu.ft. and D being the size of the sewer or channel depth. In the case of uniform distribution of load over subgrade, the shear at edge of invert is 58 $(DH + D^2)$ lb., and the bending moment at middle of base 26 $(D^2H + D^3)$ lb. per square foot.

It has been considered that the base for this type of sewer is where the variation is required. The most conservative subgrade loading is obtained where the base is of sufficient strength to transmit the arch reactions as a uniform load over the subgrade. This is nothing more than restoring conditions that existed prior to the excavation being made, the earth at the subgrade being accustomed to such pressure.

For the purpose of economy it has also been deemed advisable to confine all reinforcing steel, if required, to the base, as it can be placed there at small cost and leaves the pouring of concrete in the arch free from obstruction. There has further been the doubt as to the durability of reinforcing steel in the arch on account of the prevalence of strong sewage gases. Fig. 1 shows the thicker reinforced base adopted where such uniform distribution of pressure over the subgrade is desired, the standard steel reinforcement being based on a backfill depth over top of sewer of 20 ft. or equivalent load. Any variation from this is made in the size and spacing of the steel bars, and if necessary by increasing thickness of the base.

The thinner, plain concrete base is adopted where the subgrade material will sustain a concentration of the arch reaction at the outer portion of the base, and is the type more commonly used by way of economy when subgrade warrants. For the smaller sizes of sewer 4½ in. has been used as the minimum for the crown thickness, T, and 6 in. as the minimum for invert thickness, C.

In construction, the base precedes the arch and is allowed to project above the invert at the sides, against which projections the arch form ribs may be braced. The side projection of the base serves the dual purpose of providing ample bearing and holding the sheeting, which latter permits the removal of lower cross braces that ordinarily obstruct the arch construction. Specifications call for steel troweling of invert and covering it with building paper until completion of the sewer. The latter greatly facilitates cleaning up and produces the smoothest possible invert. Reinforcing steel shown in Fig. 1, when used, is pressed into position in the concrete at negligible cost, as the base is completed. A 1:3:5 concrete is used in the construction of this sewer with coarse aggregate not exceeding 2½ in. A limit of 1 in. should be used for the smaller sewers.

The vitrified clay lining blocks used over the arch soffit to protect the concrete from disintegration have the dimensions shown in Fig. 1, and are obtained, delivered and neatly stacked along the sewer line, at $122 per 1,000 lin.ft., or approximately $30 per ton of clay. The blocks are manufactured in clusters of three by the use of appropriate dies, as in clay pipe manufacture, and are cut to lengths specified.

In ordering the blocks, the curvature rise specified is $\frac{1}{16}$ in. greater than the rise corresponding to the shorter radius of the sewer arch. This provides a slight fluted effect which is highly desirable, as it insures the block edges fitting snugly to the center form, with resulting good joints. In fact a maximum excess curvature rise of ¼ in. is allowed to limit the number of dies required by the manufacturer, as is indicated in the table:

Block Designation	—Block Curvature, Inches— Radius	Rise	Sewer Size, Feet and Inches
A	43½ to 29	½ to ⅝	9–0 or larger
B	29 to 22	⅜ to ½	5–6 to 8–9
C	22 to 17½	⅜ to ½	4–0 to 5–3
D	17½ to 14½	⅜ to ½	3–0 to 3–9
E	14½ to 12½	⅜ to ½	2–6 to 2–9
F	12½ to 11	½ to 1	2–0 to 2–3

The standard block length is 18 in., but 2 per cent of 6-in. blocks and 3 per cent of 12-in. blocks are specified for purpose of making neat curves and maintaining proper stagger in block joints of adjoining courses. For house connection spurs there is a block 12 in. long, having an opening with spur attached in manufacture.

Fig. 2 shows a 5-ft. sewer under construction. The desirable center form, instead of having solid sheeting, has stringers attached to the arch ribs, being placed at the continuous joints between block courses. The blocks are laid over the center form in longitudinal courses, close together on all sides, without mortar, each block

being hung by two metal clips to the block course above. These clips must be rigid and are made of band iron or heavy wire, and so bent that the block may be inserted at an angle. When laid flat on the form the clip pulls the blocks snugly together. Upon completion all cavities appearing in the block joints on the inside of the sewer are pressed full of portland cement mortar by the use of rubber gloves.

Sewers of this type, built in open cut, have cost:

Size in Feet and Inches	Average Depth to Subgrade, Feet	Cost Per Foot
2-3	10.0	$6.94
2-6	10.0	7.63
2-9	8.5	9.75
3-3	10.0	13.38
3-6	8.4	12.53
5-0	11.3	22.73
5-3	10.0	24.33
5-6	7.3	20.79
6-0	9.4	26.01
6-6	7.3	28.78
7-9	9.0	39.96
10-6	5.9	43.54

The city furnishes the contractor with required materials, which are bought under separate contract. The work is being done under the direction of John C. Shaw, city engineer of Los Angeles, with W. H. Pinkham and F. A. Batty respectively office engineer and construction engineer of the North Outfall Sewer Division, in charge of the work.

Silicates in Portland Cement

A Notable Instance of International Co-operation in Research—Principal Constituent Found To Be Tricalcium Silicate

By P. H. Bates
U. S. Bureau of Standards, Washington, D. C.

MODERN scientific liberality of thought is strikingly illustrated by a recent achievement at the Bureau of Standards in Washington.

The Portland Cement Association and the Bureau have been conducting for over two years a co-operative study on the constitution and behavior of portland cement. This study, in every sense, is fundamental. And one of the most fundamental questions which may be asked is, "What is portland cement?" This question has not yet been answered in such a way as to satisfy the various investigators in the field. Even the principal constituent of clinker is not universally agreed upon. In America this is usually believed to be tricalcium silicate. In Europe some have believed it to be a solid solution of lime in dicalcium silicate; some have regarded it as a new compound, first described by Jänecke, $8CaO.Al_2O_3.2SiO_2$.

The solution of this question became, therefore, a most important problem. At the end of a year the staff at Washington again came to the conclusion that the compound described by Jänecke did not exist. In the meantime, however, another investigator in Germany, Dr. Walter Dyckerhoff, had studied the system and had reported the existence of the $8CaO.Al_2O_3.2SiO_2$. Incidentally, Dr. Dyckerhoff is a member of the firm of Dyckerhoff, internationally well known as manufacturers of high grade portland cement.

Here seemed to be the typical scientific impasse. But such situations cannot make for progress, and real progress was that which was most desired. Accordingly correspondence was initiated which resulted in a prolonged visit on the part of Doctor Dyckerhoff to the Bureau of Standards. He worked with the staff intensively for two months, with the result that entire agreement was reached on this study, and a detailed report soon will be published in a scientific journal under the joint authorship of Doctor Dyckerhoff and some members of the staff.

The question at issue was not the proof that one was right and the other wrong. The question at issue was, "What is the truth?" No hesitancy was offered to the retracting of ideas that have been shown no longer to be tenable. The conclusions of this joint study state frankly: "All of the evidence obtained in this study and presented here is opposed to the existence of a ternary compound of the composition $8CaO.Al_2O_3.2SiO_2$ stable in this system. This evidence likewise is opposed to the existence of solid solutions of the silicates and aluminates in this part of the system. It is concluded that the fiber-like crystals previously reported by some as $8CaO.Al_2O_3.2SiO_2$ are $3CaO.SiO_2$."

Such data as these may appear to the engineer to be abstract and to mean nothing toward the solution of such problems as those with which he constantly is confronted. But this is not the case. It assuredly is of interest to the engineer to know how a concrete is going to behave—to know the limitations and the possibilities of his material. To accomplish this, he must have information on the behavior of each constituent. But the behavior of each constituent cannot be ascertained except it be known what these constituents are. In like manner, most of the problems of cement chemistry are hinged upon a knowledge of the nature of the constituents. This is one of the fundamental problems which is being attacked at the Bureau of Standards. It was to the solution of a part of this problem that Doctor Dyckerhoff worked with the Bureau staff for two months. The results at this time may appear to be abstract, but as they are applied in further research at the Bureau, information of immeasurable importance to the engineer cannot fail to be evolved.

Tank Tower Wrecked by Twisting After Removal of Diagonals

Failure of an elevated sprinking tank at Peabody, Mass., last April is reported in the *Factory Mutual Record* of the Associated Factory Mutual Fire Insurance Co., Boston. It appears that the collapse was due to removal of several diagonal rod connections by men who were cleaning and painting the tower. The tank was a 15,000-gal. wooden tank, supported on a 65-ft. steel tower. The entire structure is described as less than 20 years old and of adequate design, well maintained, and in good condition. The wind velocity at the time of the accident was not more than 10 miles an hour. The collapse of the tank and tower caused large damage to nearby buildings and their contents, in addition to the total loss of the tank tower. One man was killed and a number injured. The circumstances leading up to the accident are described as follows: "Workmen were cleaning and painting the structure. In the top section of the tower they had removed three or four of the clevises by which the diagonal rods were attached to the columns. A short time later the tank rotated 180 deg. around its vertical axis and collapsed. The cause of the collapse was undoubtedly the disconnecting of several diagonal rods."

Engineering Literature

A Monthly Review of Books and a Listing of New Publications

Water-Works Handbook Brought to Date

REVIEWED BY CALEB MILLS SAVILLE

Manager and Chief Engineer, Board of Water Commissioners, Hartford, Conn.

WATERWORKS HANDBOOK OF DESIGN, CONSTRUCTION AND OPERATION—Compiled by Alfred Douglas Flinn, M. Am. Soc. C.E., etc., Director Engineering Foundation, Formerly Deputy Chief Engineer, Board of Water Supply, New York City; Robert Spurr Weston, M. Am. Soc. C. E., etc., Consulting Sanitary Engineer; and Clinton Lathrop Bogert, M. Am. Soc. C.E., etc., Consulting Engineer. Third Edition. Cloth; 6x9 in.; pp. XIV + 871; 338 illustrations, mostly diagrams and other line cuts; 312 tables; 43-p. index. $7.

In rewriting this book the authors have increased its bulk by some 47 pages over that of the first edition, a review of which by the present writer appeared in *Engineering News-Record*, Sept. 21, 1916. The appearance of the volume has been greatly improved by the substitution of maroon buckram covered boards for the flexible blue-black cloth of the first edition. The addition of an extensive bibliography at the end of each chapter is in itself more than a sufficient excuse for the purchase of the present edition especially on account of the number of references in the text which easily permit extensive research for additional data.

Very important advances made in the art of engineering during the past ten years have been well covered by the authors; many new statistical data have been collected by them and wrought into usable shape; parts of the book have been so entirely rewritten and rearranged and the inclusion of so much new material has been accomplished that the present volume seems like a new work appearing under the guise and with the familiar characteristics of an old and tried friend.

It is pleasing to find that the editors have broadened the scope of this edition to include some engineering requirements of other branches of work besides water supply and this makes the present volume of all the more value to those for whom it is primarily compiled.

The book is not a treatise on water supply subjects although it covers practically the whole range; it is not a technical manual so erudite that much of its value can be found by the ordinary practitioner only after patient search. The book is just what it purports to be, a volume crammed full of work-a-day water-works information, collected and digested by practicing engineers of the highest standing in the water-works field. As such, its contents and helpful suggestions are as available to the non-technical water-works operator as to the most restricted specialist. All through the book one finds evidence of treatment by men of broad practical experience who realize ordinary needs in contradistinction to the often narrow viewpoint of the purely technical expert derived from concentrated attention to some particular water-works problem. All of these have their place but of them a volume such as this "Water Works Handbook" is of the most general use.

Parts I, II and III—Sources of Water Supply, Collection of Water, and Transportation and Delivery of Water—are noted not only for their rearrangement but for entirely new matter superseding earlier data.

Part IV has been relieved of chapters relating to Hydraulics and Materials which have been rearranged and given the dignity of a separate part (Part V). Thirty-six pages of new matter have been added to the book and the rearrangement of the chapters has improved its balance beside giving more logical sequence. Many of the diagrams found in the first edition have been redrawn or superseded to include more recent information. Chap. 6, Watershed Development, by its increased scope is particularly rich in new matter which will be very highly appreciated by those engaged both in construction and maintenance. Chap. 9, Earth Dams or Dikes, has been increased by 10 pages and its present data combined with a long bibliography is one of the best expositions of this very important subject to be found anywhere. Chap. 16 and 17 on Plate Metal Pipes is full of the latest information, while a practically new chapter on the very up-to-date matter of concrete and reinforced-concrete pipes will fill a considerable present need. Chap. 19, Distribution Systems, has been very considerably added to by the inclusion of most important matter dealing with specific subjects such as jointing compounds, distribution losses and service pipes. Chap. 23 has been renamed Reservoir Storage and under this heading the authors discuss the latest thought on this subject as well as including construction details. Chap. 24, on Water Consumption, has been rewritten and greatly increased in its scope.

Part V, Character and Treatment of Water, has been rearranged and considerably added to, as might be expected, from the broad experience of the author of this particular part. One finds here the most reliable and up-to-date information clearly set forth.

The present edition is thoroughly up-to-date, no important matter has been omitted or even skimped, and water-works men of all grades will find themselves the better equiped by having this volume readily at hand for emergency as well as for routine work of any kind.

Our Western Railroads

THE STORY OF THE WESTERN RAILROADS—By Robert Edgar Riegel, Ph.D., Dartmouth College. New York: The Macmillan Co. Cloth; 5x8 in.; pp. 345. Boxed, $2.50.

There are many histories of individual railroads of this country and books dealing with certain features of the early days of railroad construction, but there are few which attempt to describe the development of all the railroads of any major part of the country as does this one by Robert E. Riegel, concerning the railroads west of the Mississippi River.

Roughly, a period of fifty years is covered, with enough of what went on before 1850 added to give a proper background of what has been done since the early days of the 20th Century to make the picture complete. All phases of railroad progress in the West are dealt with, the early and widely scattered lines of various gages, the attempt to get state and federal aid, the effects of the Civil War, the completion of the first trans-continental railroad and the prosperous period

which preceded the panic of 1873. With the financial recovery which followed and the exposures of waste and corruption the railroads entered a new period of public opposition marked by the beginning of state and federal regulation, keen competition and rate wars which culminated in the passing of the Interstate Commerce Act. The author divides up this period into chapters describing the Gould System, the completion of the southern and of the northern trans-continental roads, western settlements, regulation and the Interstate Commerce Act. This is followed by a chapter aptly entitled "The Reign of Giants." Other subjects of interest which the author deals with are the labor supply, labor organizations and equipment, the latter including track and roadway structures. Finally, there is an annotated bibliography of the books used as a source of information for the various chapters, in itself a valuable reference work on books dealing with railroads.

The story is well written. Maps and tabulations are omitted and the author says that they would add too much to the bulk of the volume.

From City to National Planning

LAND PLANNING IN THE UNITED STATES FOR THE CITY, STATE AND NATION—By Harlean James, A. B., Secretary of the American Civic Association and the Federated Societies of Planning and Parks. Preface by Richard T. Ely, LL.D., Professor of Economics in Northwestern University. Introduction by Albert Shaw, LL.D. New York: The Macmillan Co. Cloth; 5x8 in.; pp. 427; 50 line cuts and halftones. $5.

A NATION PLAN: A Basis for co-ordinated physical development of the United States of America, with a Suggestion for a WORLD PLAN—By Cyrus Kehr. New York: Oxford University Press, American Branch; and London, Toronto, Melbourne, and Bombay. Cloth; 7x10 in.; pp. 210; 50 halftones. $5.

A quarter of a century ago city planning was almost unknown in America, even as a technical phrase. Since then it has swept over the country becoming well established in theory with spotty examples of execution and a few notable achievements. From city to regional planning was an easy and almost necessary step, with state and national planning foreshadowed. All these phases of planning—city, regional, state and national—are considered in the first of the books named above, while the second one deals wholly with national planning, except for a few closing paragraphs suggesting a world plan. The first named of the two books is much the more concrete of the two. Most of it is concerned with city planning and the remaining portions, on regional and state planning, also deal largely with either comprehensive projects in the regional field, or with some of the component elements of planning for states. In contrast, a National Plan consists mostly of pioneer propaganda—but is all the more interesting to the forward looking.

The volume by Miss James, as befits an addition to Dr. Ely's Land Economics Series, has a wider sweep than the preceding books on planning; for, while the larger part of it goes over familiar city planning ground, the relation of planning to economics is repeatedly urged. This is most marked in the short sections on state and national planning, in which a wise utilization of land, waters and other natural resources for the benefit of the public is the key note.

Miss James' review of city and regional planning follows the general lines common to many existing books on the subject, but is fresher than the older books. It is confined almost wholly to American ideas and practice. The sections on state and nation planning, naturally enough, deal with needs and opportunities rather than accomplishments. Throughout, the volume is relatively non-technical but it is no sense amateurish. It should appeal to a large circle of readers.

It may be noted in passing that Miss James' book is "Vol. IX in the Standard Course in Real Estate outlined by the Joint Commission Representing The National Association of Real Estate Boards, The United Y.M.C.A. Schools and The Institute for Research in Land Economics and Public Utilities." Reference lists at the close of each chapter serve as guides to further reading.

In his A Nation Plan, Mr. Kehr urges that planning should proceed from the greater to the less, or from the nation through its states and then through its cities. He advocates co-ordinated planning, thus bringing railways, waterways, highways, ports, cities, etc., into line with each other and the growth and needs of population; new ports, railways, cities, etc., and the abandonment of old if they do not fit the nation plan. Inland transportation he would base on an ideal triangular system of routes, as far as topography and broad economic considerations permit, and quite regardless of local and political claims, although he would use, with improvements, as needed, existing routes of travel and traffic where feasible without undue sacrifice to a far seeing ideal plan.

Mr. Kehr is vague almost to blankness as to both the governmental and financial ways and means of preparing and executing a nation plan. This is wise. The public, or a portion of it, must be brought to see the need and advantages of co-ordinated nation planning before going into ways and means. Details at the outset would bred dissension and divert attention from the primary issue.

As to both books, it may be noted that great as the recent awakening to the need for planning has been, little has yet been accomplished and many as are the plans worked out privately or officially—few of the plans have yet been put under execution. In the municipal field, by far the most has been accomplished in zoning. There is a lesson in this for regional, state and national planning. Zoning accomplishments and most of the achievements in the branches of city planning have been based on careful surveys of existing conditions and trends of growth and needs. Various surveys of state and national resources, means of transportation, etc., noted in these books, have already been made. How they may be carried forward and utilized in a more comprehensive planning than has yet been attempted these books indicate in part, besides being fruitful in suggestions.

British Contracts and Specifications

CIVIL ENGINEERING SPECIFICATIONS AND QUANTITIES—By G. S. Coleman, D.Sc. (Eng.), Assoc. M. Inst. C. E., Director of the Department of Municipal and Sanitary Engineering, University of Manchester; and G. M. Flood, B.Sc. (Eng.), Assoc. M. Inst. Municipal and County E., Lecturer in Municipal and Sanitary Engineering, University of Manchester. London and New York: Longmans Green & Co. Cloth; 6x9 in.; pp. 282. $3.75.

In well written English, as free from technicalities as any engineer or contractor could wish, the authors have outlined the law of contracts as applied to civil engineering construction, the main essentials of specifications, and various related matters, including arbitration procedure. The book deals chiefly with conditions in England, but some consideration is given to both Canadian and American law and practice. There is a

list of references to American books in this field but it does not include either Johnson's "Engineering Contracts and Specifications" or Wait and Waddell's "Specifications and Contracts."

The opening chapter deals with the civil engineer, his duties, authority and liabilities. There are three chapters on contracts, and nine on specifications, the latter divided into four on materials of construction and five on workmanship. Eight chapters deal with schedules, quantities, orders, tenders, certification of work for payment, including extras. A separate chapter is devoted to guarantors and sureties, and there is a chapter on arbitration.

Although written primarily for the British, the book is well worth the attention of broad-minded engineers having to do with contracts and specifications in any part of the world.

Problems of Deep Tunneling

DER BAU LANGER TIEFLIEGENDER GEBIRGSTUNNEL—Von C. Andreae, Professor an der Eidgenössischen Technischen Hochschule, Zürich. Berlin: Julius Springer. Paper; 6x9 in.; pp. 151; 83 line drawings and halftones. 13.2 reichsmarks in Germany.

Prof. C. Andreae's monograph, "The Construction of Long and Deep Mountain Tunnels," is an authoritative review of Alpine experience in the difficult problems presented by rock pressure and plastic flow, high ground temperature and large water inflow. The author's own work in connection with the Simplon and other recent Alpine tunnels of great length make his statement of the situation first hand and specially valuable. Probably the most important section of the book is that dealing with the relation of rock structure and geological prognostication to the factors of pressure, temperature and water. This section contains a large number of conclusions and suggestions that will be of value to those having similar deep work. The sections which discuss cooling by air draft and by water sprays, and those on timbering and lining, are also of value.

The Great Lakes and Their Ports

TRANSPORTATION ON THE GREAT LAKES: The Board of Engineers for Rivers and Harbors, War Department, in Co-operation with the United States Shipping Board. Paper; 6x9 in.; pages 426. $1.50 from Superintendent of Documents, Washington, D. C.

As the first volume of a series dealing with transportation problems directly related to the functions of the War Department, the Board of Engineers for Rivers and Harbors, co-operating with the United States Shipping Board, has prepared this volume giving data concerning the various kinds of shipping upon the Great Lakes and information concerning the principal ports on the lakes. This new series is similar to the Port Series now being published under the same auspices but this first volume is even more comprehensive as it not only gives statistics concerning the commerce on the lakes but it also gives information concerning the sources of the commerce. For instance, under the chapter entitled "The Ore Movement" the volume gives a brief description of the principal iron ranges which supply the ore moved on the Great Lakes.

The contents of the book is best summarized by the titles of the various chapters: General Description of the Great Lakes and Their Connecting Channels and Harbors; Laws, Treaties and Regulations; Vessels of the Great Lakes Commerce; The Grain, Ore and Coal Movements; Other Bulk Freight; Package Freight; and Car Ferry Traffic.

In order to get complete data, the compilers of the book had to go outside the United States. From data provided by the Dominion of Canada they have been able to include statistics for the Great Lakes ports on the Canadian side of the border.

The Activated-Sludge Process

THE ACTIVATED SLUDGE PROCESS OF SEWAGE TREATMENT: With Brief Descriptions of Several Plants, Comparative Tables on Plant Design and Operation, Data on Sludge Disposal and Other Information of Interest to Sanitary Engineers—Prepared and Published by General Filtration Company, Inc., Rochester, N. Y. Heavy paper; 6x9 in.; p. 88; halftones and line cuts. Free on application to all engineers and city officials who have a proper interest in the subject.

The company named above has now brought out for the third time a considerable amount of descriptive and other information relating to the activated-sludge process of sewage treatment. Except for the virtually unavoidable use of the trade name "Filtros" and the appearance in two or three places of the name of the company which makes the plates so named, the pamphlet contains nothing of an advertising nature. The larger part of the contents is made up of either condensations of papers written by various engineers or of material prepared expressly for this pamphlet by engineers. These papers deal in some cases with the activated-sludge process and in other cases describe plants actually constructed. Special sections deal with the testing and rating of filtros plates, the orifice method of rating and with plate containers. There are seven pages of tables of comparative plant design and operating data relating to a dozen plants. It is reasonable to expect that every sewage-works engineer will embrace the opportunity afforded to obtain this pamphlet for his working library.

Publications Received

THE HIGH STANDARD OF USEFULNESS of the *World Almanac* is continued in the issue for 1927 which is the forty-second. (Paper, 60 cents, or cloth $1.10, postpaid from *The World*, New York City.)

PUBLIC MANAGEMENT is the new name taken by the *City Manager Magazine* with its January issue, which begins its ninth volume. (Lawrence, Kan.: The International City Managers' Association; $4 a year or 50c. per monthly issue.)

OPPORTUNITIES FOR ENGINEERS in the United States Civil Service is the title of a small pamphlet published by the United States Civil Service Commission, Washington, D. C. Besides explanatory matter, the pamphlet contains a table showing salaries and distribution of government engineers.

DISCUSSIONS ON THE ST. LAWRENCE Ship Canal are given in Vol. IV, No. 4, of the Reference Shelf (H. W. Wilson Co., New York, 90c.), a collection of reprints of articles, briefs and references which have appeared since a similar volume of the Reference Shelf was reprinted in 1924, Vol. I, No. 3. The book is arranged in the form of a debate with affirmative and negative references.

DIAMOND DRILLING, an illustrated pamphlet of 176 pages, by Frank A. Edson, is written particularly for those interested in oil-field prospecting and development, but contains much information of value for anyone concerned with diamond drilling for any purpose. The pamphlet is Bulletin 243 of the U. S. Bureau of Mines. (35c. from Superintendent of Documents, Washington, D. C.)

THE RULING AND DISSENTING OPINIONS in the recent U. S. Supreme Court decision in the Indianapolis Water

Company Case, in which the majority of the court ruled for "spot" reproduction cost value, have been printed for distribution by Sanderson & Porter, engineers, New York, Chicago, and San Francisco. An abstract of the opinion, with editorial comment, appeared in *Engineering News-Record*, Dec. 2, 1926, pp. 923 and 895.

AMONG THE PAPERS composing bulletin 6 of the Faculty of Applied Science and Engineering School for Engineering Research of the University of Toronto (Ont.) are: The Application of Certain Projections to the Construction of General Maps of Canada, by Louis B. Stewart, professor of surveying and geography; Reinforced Concrete Poles, by Peter Gillespie, professor of civil engineering, and F. E. Wilson, research assistant; and Intakes for Power Plants, by Robert W. Angus, professor of mechanical engineering.

THE RAILWAY GRADE REDUCTION PROBLEM is the title of a bulletin of the Agricultural and Mechanical College of Texas (College Station, Tex.; free). It is made up of an application of recent data on the subject of grade reduction to the solution of a grade reduction problem on a typical railroad district of 200 miles. The data are taken chiefly from the bulletins of the American Railway Engineering Association. The author states that he knows of no other book in which all these data are brought together in similar form.

MARINE BORERS AND METHODS OF COMBATING them are outlined in a progress report on investigations conducted by the chemical warfare service of the United States War Department which is published as a bulletin of the American Railway Engineering Association (431 South Dearborn St., Chicago, Ill.) as Bulletin 290, October, 1926. The report is very complete and contains many plates illustrating the various types of borers and results of their attacks upon piling, and many tables concerning results of treatment with various chemicals.

THE FIRST FOUR of six pamphlets, containing instructions relating to the topographic work of the U. S. Geological Survey, are now available. The four cover administration, triangulation, transit traverse and leveling and are designed to serve as a manual of instruction and practice, not only for those of the Survey but for personnel of other organizations engaged in topographic surveying. An attempt has been made to have the instructions complete so far as the technical work of topographic mapping is concerned. (10c. a copy for each of the bulletins, from Superintendent of Documents, Washington, D. C.)

A STUDY of the enlargement of cities by the annexation of outlying territory (Municipal Annexation of Land) has been made by the Civic Development Department of the Chamber of Commerce of the United States (Washington, D. C.) for the benefit of its member organizations. The report is signed by Dorsey W. Hyde, Jr., assistant manager, Civic Development Department, and the foreword is by John Ihlder, manager of the department. It reviews the history of annexation and consolidation, law and procedure, gives arguments for and against, tells how annexation works out, and sets up standards for annexation procedure. The study is concerned chiefly with large American cities.

THE PLEASANT SURPRISE in the latest report (year ended March 31, 1926) of Sir Alexander Houston, director of water examinations, Metropolitan Water Board of London, is a section entitled The Romance of the New River, consisting of some thirty large quarto pages of text and many plates (maps and halftone views.) The New River was a gravity water supply brought some forty miles to London by Sir Hugh Myddleton and Associates over three hundred years ago and still an important part of the water supply of "Water London." The whole course of New River is described in two-mile sections, with numerous personal, literary, historical, topographical, and even mythical or traditional allusions. Besides a reproduction of a portrait based on an engraving from an oil painting of Sir Hugh Myddleton, the text pays repeated tribute to this pioneer among private water company promoters. The author lays particular stress on Sir Hugh's enterprise as an early and practical example of preventive medicine and cites chlorination and other works established by the Metropolitan Water Board as having been carried out in the spirit of the original promoter. A part of the story of this great waterworks enterprise is told by means of quotations from an old novel entitled "The New River," by Edward Fitzgibbon. Besides The Romance of the New River, which is a distinctive contribution to the literature of engineering and sanitation, Sir Alexander's report for 1925-26 (his twentieth) contains the usual descriptions of the year's work, including numerous analytical tables. (21 sh., from P. S. King & Son, 2 Great Smith St., Westminster, England.)

New Books and Revised Editions

[Those desiring copies of the books listed below or mentioned elsewhere in this section should order them from the publishers or from their local booksellers.]

ART DE L'INGENIEUR ET METALLURGIE (ENGINEERING AND METALLURGY): Resistance des Materiaux et Données Numériques Diverses—Redigées par L. Descroix, Ingénieur, Ancien Élève de l'Ecole Polytechnique, directeur administratif de *La Revue de Metallurgie*. Préface de Sir Robert Hadfield, Bt. F.R.S., M. Corres, de l'Academie des Sciences. Extrait du Volume V, Années 1917-1918-1919-1920-1921-1922. (Tables Annuelles de Constantes et Données Numériques—Publiée sous le patronage du Conseil international des Recherches et de l'Union internationale de la Chimie pure et appliquée). Paris: Gauthier-Villars et Cie. Cambridge (England): Cambridge University Press. Chicago (Ill.): University of Chicago Press. Heavy paper; 9x11 in.; 249 pp. (1660-1908) of tables; illustrated. Paper, 105, cloth, 126 francs in Paris.

Tables and diagrams of various constants used in engineering and metallurgy, extracted from the larger work indicated in the title for the period (1917-1922). Mention of the latest issue of the larger work was made in these columns, under Publications Received, Dec. 16, 1926, p. 1,007.

CHARACTER OF THE GROUND-WATER RESOURCES OF ARIZONA—By C. N. Catlin, Associate Professor of Agricultural Chemistry, and Associate Chemist in the Agricultural Experiment Station. Tucson, Arizona: University of Arizona: Paper; 6x9 in.; pp. 293; 16 tables.

DER DURCHLAUFENDE TRÄGER ÜBER UNGLEICHEN ÖFFNUNGEN: Theorie, Gebrauchsfertige Formeln, Zahlenbeispiele—Von Dr.-Ing. Emil Kammer, ord. Professor für Ingenieurwissenschaften an der Technischen Hochschule, Darmstadt. Berlin: Julius Springer. Paper; 6x9 in.; pp. 269; 303 line cuts and 4 plates. Paper, 25.5, cloth, 27.5 reichmarks in Germany.

ERDDRUCK, ERDWIDERSTAND UND TRAGFÄHIGKEIT DES BAUGRUNDES: Gesichtspunkte für die Berechnung, Praktische Beispiele und Erddrucktabellen—Von Dr.-Ing. e. h. H. Krey, Overregierungs—und Baurat. Dritte ungearbeitete und erweiterte Auflage. Berlin: Wilhelm Ernst & Sohn. Paper; 6x9 in.; pp. 296; 208 halftones and line cuts; 117 tables. Paper, 21.6, cloth 23.4 reichmarks in Germany.

DIE KRAFTFELDER IN FESTEN ELASTISCHEN KÖRPERN UND IHRE PRAKTISCHEN ANWENDUNGE—Von Dr.-Ing. Th. Wyss, Privatdozent für Statik und Bruckenbau an der Technischen Hochschule, Danzig. Berlin: Julius Springer Cloth; 6x9 in.; pp. 368; 432 line cuts in text and 35 tables of structural details. Cloth, 25.5 reichmarks in Germany.

MECHANICAL WORLD YEAR BOOK, 1927. Manchester (England): Emmott & Co., Ltd. Cloth; 4x7 in.; pp. 348; illustrated. 1s. 6d. net.

METROPOLITAN STREET TRAFFIC SURVEY: Report and Recommendations prepared under the Direction of the Street Traffic Committee of the Chicago Association of Commerce by Miller McClintock, Director of the Albert Russel Erskine Bureau for Street Traffic Research, Harvard University. Chicago, Ill.: Chicago Association of Commerce. Cloth; 9x11 in.; pp. 202; numerous tables, diagrams and views. $5.

A permanent traffic commission, a division of traffic engineering in the department of public works and a new traffic ordinance are among the recommendations of this report. Its scope may be judged from its chapter heads: (1) Purpose and methods of the survey; (2) street use; (3) increased density of street traffic; (4) complications of street traffic; (5) economic effects of congestion; (6) traffic accident problem; (7) traffic control problem; (8) pedestrian problem; (9) parking problem; (10) traffic police; (11) traffic signs and signals; (12) the courts and traffic cases; (13) administrative responsibility; (14) recommendations and proposed ordinance.

MODERNE GRUNDBAUTECHNIK—I Teil: Die Kurz-Schachtgründungen mit der Grundkörpermachine—von Ing. I. Zeissl, Direktor der Stern-Gesellschaft für Moderne Grundbautechnik, M.B.H. Berlin: Wilhelm Ernst & Sons. Paper; 5x8 in.; pp. 64; 29 line cuts and halftones; 3 tables. 7.2 reichsmarks in Germany.

PRAKTISCHE STATIK: EINFUHRUNG IN DIE STANDBERECHNUNG DER TRAGWERKE MIT BESONDERER RUCKSICHT AUF DEN HOCH UND EISENBETONBAU—Von Rudolf Saliger, Dr. Ing., ord. Professor an der Technischen Hochschule in Wien, usw. Zwelte, teilweise umgearbeitete und erweiterte Auflage. Leipzig und Wien: Franz Deuticke. Paper; 7x10 in.; pp. 646; 650 line cuts. Paper, 30 reichsmarks, bound, 49.5 reichsmarks, in Germany.

STATISCHE PROBLEME DES TUNNEL—UND DRUCKSTOLLENBAUES UND IHRE GEGENSEITIGEN BEZIEHUNGEN: Gleichgewichtsverhältnisse im massiven und kreisförmig durchörteterten Gebirge und deren Folgeerscheinungen, Spannungsverhältnisse unterirdischer Gewolbebauten—Von Dr. sc. techn. Hanns Schmid, Ingenieur E. T. H., Chur. Berlin: Julius Springer. Paper; 6x9 in.; pp. 148; 36 line cuts. Paper, 4 reishmarks in Germany.

TECHNISCHE HYDRODYNAMIK—Von Dr. Franz Prasil, Professor an der Eidgenössischen Technischen Hochschule in Zürich. Zweite umgearbeitete und vermehrte Auflage. Berlin: Julius Springer. Cloth; 6x9 in.; pp. 303; 109 halftones and line cuts. Cloth, 24 reichmarks in Germany.

Letters to the Editor

A Forum for Discussion of Views of Engineers and Contractors

Price Current Meter: Serviceability vs. Scientific Design

Sir—Permit me to add a word to what has been said lately in your columns on the subject of the Price current meter. Two points need emphasizing.

(1) The pamphlet by Dr. Staus which Mr. Gutmann reviewed in your issue of Nov. 18, 1926, p. 840, discusses current meters primarily from the point of view of their adaptability to turbine testing, not to stream gaging. His findings, to the effect that under conditions of turbulent flow the Price meter cannot be relied upon to give accurate results, is an old story in this country. Experiments made by B. F. Groat of Philadelphia, also in connection with turbine testing, established this clearly about fifteen years ago. Nevertheless, the usefulness of the Price current meter for stream gaging has not been impaired. It has given dependable results for thirty years. Like any sensitive instrument proper precautions must be taken in its use, and one of these is that in turbulent or eddying types of flow it should not be used at all.

(2) The Price current meter was adopted in 1897 as the official instrument of the U. S. Geological Survey because of its *serviceability* for stream gaging purposes, not because its design was considered to be especially good. The facts are as follows: The stream gaging activities of the U. S. Geological Survey first began in 1896. There were in use then by the Hydrographic Division of that bureau (later it became known as the Water Resources Branch) current meters of different makes. The writer, who happened to be among the first engineers employed in the new office, had occasion to work with all of the meters and part of his duties consisted in rating them in the pond at Chevy Chase, Md. The rating facilities there were of a high order for those early days, and current meters were shipped from many distant points to be rated at this station. The writer has distinct recollections regarding the behavior of some of the current meters that passed through his hands, at the rating station in actual stream gaging work.

Briefly summarized, some of the current meters that were built on good scientific principles failed utterly of being serviceable instruments. Among these were instruments of the direct screw or propeller type, the main features of which were excellent but the details of construction of which were so poor as to render them worthless for practical work. There were also several meters of the revolving cup variety, among them the Price meter. It is an interesting fact that although these instruments were far from scientific they happened to be extremely serviceable. The Price meter, though then not as well made as it is now, was the most servicable instrument of all, and its makers are to be commended for sparing no pains in improving it and in acting on suggestions. As a result, the Price meter was adopted because it was best liked by those who had to use current meters daily, and were in position to judge in a *practical* way.

A current meter to be *serviceable* should conform to the following specifications: Its construction should be such that under hard and continuous use the relation between revolutions and velocity of water should not alter sensibly—in short, the meter should "hold its rating," as it is called. The main bearing should not have to depend on oil or other lubricant for its proper functioning and should be as nearly rust-resisting as is practicable to provide in a metal instrument. The instrument should be as light as possible consistent with strength, and be easily carried or shipped; it should be easily taken apart, cleaned, and put together again without affecting its rating; it should not have to depend upon frequent refined adjustments by an expert mechanic for staying in good condition. When used under identical flow conditions it shou'd give constant results. It should work equally well in highly turbid as in clear water and not be easily clogged with floating matter.

The Price meter attracted attention in the early days of stream gaging by its adaptability to the varying exigencies of the government service. It was carried through Maryland on the handle bars of a bicycle neatly put up in a box less than a foot in length; the first stream gaging work done on the headwaters of the Appalachian mountain streams required its being carried strapped to the saddle; in Western work it was frequently transported lashed to a pack mule; the writer recalls "bumping along" over seemingly endless miles of bunchgrass prairie devoid of roads in a buckboard with the meter strapped to the slats. But, somehow, the instrument always came out of its box none the worse for these severe tests.

Within the past thirty years the writer has seen a number of new designs for current meters intended to obviate the limitations of the Price meter as regards use in turbulent waters, cross currents and eddies. Only one, the Hoff meter invented by Ed. J. Hoff, appears to give any promise of success, and its design is the result of more than a quarter of a century of study on the part of its inventor. The instrument is unquestionably scientifically designed and combines many excellent features. How serviceable it will prove, time and practical use under a variety of conditions alone can tell. And the same may well be said about the latest model of the German Ott meter described by Dr. Staus.

GERARD H. MATTHES,
Consulting Engineer.

New York City,
Jan. 3, 1927.

Old Strap Railroad Rails

Sir—Apropos of the article entitled "Unusual Rail Dug Up in Illinois," in your issue of Dec. 30, 1926, p. 1077, I remember in my childhood hearing old people talk of these strap rails on the New York Central R.R. at Rochester, N. Y. Sometimes one end of such a rail would become loose and curl up, piercing the floor of a passenger car and doing considerable damage. These curled up rails were called "snakes."

W. BISSELL.

Philadelphia, Pa.
Jan. 3, 1927.

Hydraulic Jump Formulas

Sir—In the article on "Determining the Energy Lost in the Hydraulic Jump," by J. C. Stevens, which appeared in *Engineering News-Record*, June 4, 1925, p. 928, Mr. Stevens states that his equation 11,

$$\frac{V^2}{2g} = \frac{y_c}{2}$$

expresses the condition for critical flow, viz.: that velocity head is one-half the depth. It is printed

$$\frac{V}{2g} = \frac{y_c}{2}$$

but the $\frac{V}{2g}$ is evidently a typographical error.

Recently in computing the critical depth for an irregular shaped channel, in which the bottom sloped from side to side, I noticed that the critical depth as shown by the $d + hv$, and the $P + \frac{Q}{g} V$ (see article by Julian Hinds, *Engineering News-Record*, Nov. 25, 1920, p. 1035) curves did not agree with the equation 11 mentioned.

It seems desirable to call attention to the fact that equation 11, in fact all equations from 7 to 18, apply only to rectangular channels, as P, the pressure of water in a vertical plane (one of the factors used in deriving the equations) represents the total pressure across the whole channel section, and if y = depth of water, i.e., the maximum depth, then $P = \frac{1}{2} y^2$ is correct only for rectangular channels with vertical sides.

In a recent edition of a well-known textbook on hydraulics occurs the following statement: "For water flowing in an open channel . . . there is a so-called critical depth. This occurs when the velocity head equals one-half the depth, that is when $V^2 = gD$." Here again it might be inferred that this statement applied to channels of all shapes, whereas it is true only of rectangular channels.

As a matter of fact it can be shown that at the point of critical depth in a triangular shaped channel the velocity head is one-fourth the depth instead of one-half.

FRANK S. BAILEY,
Assistant Engineer, Metcalf & Eddy.

Boston, Mass.,
Dec. 10, 1926.

News of the Week

Current Events in the Civil Engineering and Contracting Fields

John F. Stevens Is Elected Am. Soc. C.E. President

Famous As Railroad Engineer—Was Panama Canal Chief Engineer—Service International

John F. Stevens, inducted into office yesterday as president of the American Society of Civil Engineers, is a native of Maine, having been born at West Gardiner, April 25, 1853. Technically he is a self-trained man, having started engineering work after attending the common schools and the state normal school at Farmington, Me., where he began engineering work.

He continued his engineering experience in the West; in 1874 and 1875 in the Minneapolis city engineering department; then two years on railroad surveys in Texas; two years as assistant engineer on the Denver and Rio Grande R.R. and in 1880 and 1881 as locating engineer on the Chicago, Milwaukee & St. Paul. Three years were then spent with the Canadian Pacific on location and construction, then again with the Milwaukee, and then two years with the Duluth, South Shore & Atlantic as principal assistant engineer.

SERVICE WITH RAILROADS

Mr. Stevens entered the service of the Great Northern Ry. the latter part of 1889, in which position, as locating engineer in the Rockies and later constructing engineer, he won his spurs as a railroad builder. In 1903 he was made chief engineer of the Chicago, Rock Island & Pacific Ry., the following year its second vice-president, and in 1905 was appointed chief engineer of the Panama Canal and chairman of the Isthmian Canal Commission.

Previous to his entering consulting practice he was appointed, in 1907, vice-president of the New York, New Haven & Hartford in charge of operation, a position he held two years, then to become president of the Spokane, Portland & Seattle Ry. and the Oregon Trunk Ry., during which time the latter road was built.

WORK IN SIBERIA

In May, 1917, Mr. Stevens was appointed the chairman of a commission of railway engineers sent to Siberia by the United States in response to a request made by the Kerensky government. This commission made recommendations to increase the effectiveness of the 5,500 miles of road that stretched from Kola Bay to Vladivostok. In 1923 he returned to the United States and resumed his consulting practice.

Mr. Stevens has received honors from governments as follows: United States, Distinguished Service Medal; France, Officer of the Legion of Honor; Japan, Second Class Order of the Rising Sun; China, Order of Chia Ho (highest civil decoration) and Order of Wen Hu (highest military decoration); Czechoslovakia, Military Cross. He is an honorary member of the American Society of Civil Engineers and the Association of Chinese and American Engineers. He was awarded a degree of Doctor of Laws from Bates College in 1925, and he is a holder of the John Fritz Medal. He became a member of the American Society of Civil Engineers in 1888.

Newly-Elected President of American Society of Civil Engineers

John F. Stevens

Everglades Survey Is Proposed

A bill to authorize an examination of the Florida Everglades by the Bureau of Reclamation has been introduced in Congress. The examination is proposed "with a view to co-operation on the part of the federal government with the State of Florida" in the reclamation of the Everglades.

Results of Am. Soc. C. E. Ballot

Officers of the American Society of Civil Engineers chosen in the election yesterday are: President, John F. Stevens, with 3,560 votes out of 3,642 cast and 3,598 counted; vice-president of Zone II, John C. Hoyt, 3,362 votes; vice-president of Zone III, Arthur E. Morgan, 3,368 votes; directors—District No. 1, George J. Ray, 3,350 votes; and George L. Lucas, 3,342 votes; District No. 4, Frank O. Dufour, 3,323 votes; District No. 11, Harry W. Dennis, 3,350 votes; District No. 14, Con M. Buck, 3,322 votes; and District No. 15, Jacob H. Brillhart, 3,329 votes.

Civil Engineers Begin Annual Meeting

New Methods of Electing President Are Proposed—Active Local Sections to be Aided

The annual meeting of the American Society of Civil Engineers began yesterday morning at the Engineering Societies Building, New York City, with the formal presentation of medals and prizes for papers before the society. Details of awards are given on p. 129.

At the business meeting which followed the presentations, the committee on Deferred Amendments presented a substitute amendment for the two now before the society for the election of officers. The gist of the new amendment is that the official nomination for president be made by a committee of twenty made up of the eighteen directors and two past-presidents. No change is proposed in the method of electing vice-presidents and directors. Secretary Seabury, in his report, stated that the 57th St. property had been leased for 65 years at a very advantageous figure.

The Board of Direction reported that it had authorized the appropriation of $4,000 for the continuation of the Stevenson Creek Dam tests, also that it had authorized the making of a survey of the activities of allied societies to determine whether there was overlapping and duplication of effort.

The Board of Direction has appointed a committee on Scope to advise whether or not it is advisable to undertake a study for the possible solution of the transportation problem of the country. The Board of Direction proposes a change in the present method of alloting support to the local sections on a flat rate of $2 per member by increasing the allotment to very active sections in the need of assistance to $3 upon the recommendation of the committee on Local Sections.

Merger of Northern Pacific and Great Northern Proposed

Plans for the consolidation of the Northern Pacific and Great Northern railroads are being prepared by representatives of the two roads now meeting in New York City, in order to present them to the Interstate Commerce Commission for approval in the near future. It has been stated that the inclusion of the Chicago, Burlington & Quincy R.R. and the Colorado & Southern Ry. is not being considered at the present time, but as these two roads are controlled through stock ownership it is expected that they will be included ultimately. The system will have a total of 14,900 miles with the Great Northern and Northern Pacific alone, and of 25,300 with the other two railroads added.

Hayden Opposes Boulder Canyon Bill

Minority Opinion Cites Basic Law of Water Appropriation Is Violated in Bill

An exhaustive minority report on the Boulder Canyon Bill recently reported to the House of Representatives, with a favorable report by the Committee on Irrigation and Reclamation, has just been submitted to the House by Representative Hayden, of Arizona, a member of that committee. This urges that for a number of reasons the bill do not pass. The most important reasons are that the bill violates the basic law of water appropriation which holds throughout the West, that it is not within the power of Congress or the legislatures of six of the seven basin states to divide and apportion the waters of the Colorado River and its tributaries, that the bill falsely purports to authorize the construction of a federal reclamation project although its essential purpose is to establish a government power project, and that flood protection can be secured by other means for less than one-third of the expenditure contemplated in the bill.

Brief on Water Rights

In support of the first reason, Representative Hayden gives a lengthy legal brief on the subject of Western water rights, the doctrine of appropriation, the vesting of appropriation control in the states and not in the Federal Government, and the inability of mere ownership of land along the river to carry with it control of the waters of the river (the Federal Government has retained the ownership of all lands in Arizona bordering on the Colorado River). He demands for the state of Arizona, as fair and reasonable, (1) an equal division with California of the available water in the Colorado, after conceding to Nevada all water capable of use by that state; and (2) the right, jointly with Nevada, to collect each year from any hydro-electric power produced by the Federal Government on the Colorado River a sum equal to the taxes which would be paid if the same site were owned and developed by private enterprise. He cites the fact that payments in lieu of taxes are now made to the public land states by the Federal Government out of income derived from coal, oil, gas, and other natural resources, and indicates that hydro-electric power should be dealt with on the same basis.

On the subject of flood control he says: "The Federal Government has the same obligation to prevent destruction by floods on the Colorado River as upon the Mississippi, the Ohio, the Sacramento, or any other great American river." He then says that the cost of the proposed work is not required for flood protection, as only 8,000,000,000 acre-feet out of 26,000,000 total capacity of the Boulder Canyon Reservoir are set aside for flood control purposes. As to a flood control project he says: "If Congress will provide $35,000,000 for the purpose, to be advanced either to the state of Arizona or to a Colorado River water power authority created by contact between the interested states, I am sure that such a sum would be the total amount of money which the Federal Government ever need contribute. With $30,000,000 of initial capital any agency could readily finance the building of one or more dams to completely control the Colorado River by raising whatever additional money that might be needed through credit obtained from contracts for the sale of hydro-electric power."

The report also asserts the southern California Coast cities do not need to obtain domestic water from the Colorado, discusses the navigability of the Colorado at Boulder Canyon and says that the proposed dam would destroy this navigability, asserts that regulation of Colorado River flow would benefit Mexican lands by making water available for their irrigation and states that Arizona would prefer a dam at Glen Canyon to that at Boulder Canyon.

He finally proposes that "to avoid the waste and mismanagement which are so often incident to the conduct of large operations by the Federal Government" a Colorado River authority be created similar to the Port of New York Authority which apparently would be expected to construct a development "for the combined purposes of flood control, irrigation and power" at national expense. He also proposes that an understanding be secured among the several states of the Colorado River Basin as to an equitable apportionment to the several states of the waters of the Colorado.

Engineering Fifty Years Ago

From *Engineering News*
Jan. 20, 1877

A MEETING of persons interested in canal navigation was held, a few weeks since, at Buffalo, to see what measures could be taken to improve the efficiency of these waterways and to revive the traffic. The Belgian system of towing by cable on the bottom of the canal was strongly advocated, and additional steps were suggested for inaugurating such a system; but it was stated that there was already no legal hindrance to the introduction of the plan, and that whenever any one wished to introduce train boats they could do so. One party urged the laying of a T-rail upon piles on the tow path, using small locomotives for traction.

Sewage Plant Operators' Course Opens with 20 Enrolled

The short course for sewage plant operators at Rutgers University, New Brunswick, N. J., opened on Jan. 17 with an enrollment of 20, including two each from New York and Ohio, and one each from Connecticut and Delaware. The school is in general charge of Harry N. Lendall, professor of municipal and sanitary engineering at the institution already named.

Toll Bridge Owners Form National Association

St. Louis Meeting Expresses Strong Opposition to the Attitude of Public Roads Bureau

(Special Correspondence)

At the invitation of Eli T. Watson, president of the New Orleans Pontchartrain Bridge Co., 25 men representing about forty of the largest toll bridge owners and operators throughout the country met at Hotel Statler, St. Louis, on Jan. 17, to discuss the formation of an association to deal with their problems.

The meeting was addressed by ex-governor Sanders, of Louisiana, who spoke on the pressing need for such an organization as a co-operative measure, to secure proper interchange of ideas and information, and for mutural benefit. He laid special stress on the need of concerted action in legislative matters and pointed out many instances where, he said, toll bridge interests have suffered from snap legislation. Gov. Sanders' ideas were concurred in almost unanimously by other speakers, who also voiced the general sentiment of the meeting as being violently opposed to the attitude of the Bureau of Public Roads, which has recently announced a policy whereby no federal aid will be extended to roads leading to toll bridges.

Permanent Organization

A permanent organization was perfected and a constitution adopted. Officers and directors elected include O. H. Klatt, San Francisco, as president, and E. A. Roebry, St. Louis, as vice-president. The objects of the association as expressed in the Constitution are: to provide a clearing house for statistics relating to toll bridges, to secure favorable publicity, to foster local and national legislation favorable to toll bridge owners, and to resist by all fair means any legislation not favorable. An executive meeting of the newly elected directors was called for Jan. 18.

The association expects soon to open permanent headquarters in Washington and to employ an executive secretary to handle its interests before Congress and the U. S. Bureau of Public Roads. The name of the new organization will be the National Association of Highway Bridges.

Plan Would Convert Bryant Park Into Bus Terminal

Recognizing that soon the city must take greater cognizance of the growing traffic problem, especially the parking and terminal spaces for giant motor buses, in order to alleviate the overcongested highways of midtown Manhattan, a plan, preliminary details of which have been worked out by the Board of Transportation, has been suggested for the construction of a municipal bus station under Bryant Park, west of the Public Library, in the heart of the theatrical, hotel, shopping and business centers, on a direct line along Sixth Ave. from the New York & New Jersey Vehicular Tunnel and to 57th St., to the Queensboro bridge.

American Society of Civil Engineers Awards Medals and Prizes

JULIAN HINDS, who was awarded the Norman Medal for his paper on "Side Channel Spillways; Hydraulic Theory, Economic Factors, and Experimental Determination of Losses," is a native of Alabama and a graduate of the civil engineering school of the University of Texas, Class of 1908. After graduation he served for a year as instructor in civil engineering at the University of Texas. He next went with the Gulf Texas and Western Ry., on construction work, for a short period, after which he was employed for a year in the Chicago office of the Chicago, Milwaukee and St. Paul Ry.

In 1910 he entered the employ of the United States Bureau of Reclamation, as surveyman, on the Yakima Project in Washington. He went from Yakima to Elephant Butte Dam, as designer of dam and plant, and later to the central office of the Bureau at Denver, where he served successively as designer, chief draftsman and assistant designing engineer.

In the summer of 1926 he went to Aguascalientes, Ags., Mexico, as resident engineer for the J. G. White Engineering Corporation, S. en C., on the construction of the Calles Dam and the Santiago Irrigation Project, for the Mexican Government.

CLARENCE S. JARVIS, who was awarded the J. James R. Croes Medal for his paper on "Flood Flow Characteristics," has had a varied experience with problems of stream flow and flood control. Field work with the U. S. Geological Survey and the Reclamation Service, hydro-electric developments, private irrigation projects, municipal water supply, drainage, and highway construction required contact with runoff data.

Among the flood-control projects with which he has been identified are the Provo Reservoir and the Sevier River projects. Also, while engaged in making an investigation of possible future water supply for Benicia Arsenal, California, as Captain of Engineers, U. S. Army, in 1919, he outlined a tentative plan for "The Control of Flood and Tidal Flow in the Sacramento and San Joaquin Rivers, California," which appeared in *Transactions*, American Society of Civil Engineers, 1921. During recent years the U. S. Reclamation Service has been engaged in gathering data pertaining to this proposed project, and a preliminary report has been rendered, with estimates of cost for salt water barriers at alternate locations.

Mr. Jarvis graduated from Missouri State University with B.S. in C.E., 1906, and C.E., 1908; also from Michigan State University, M.S.E., 1925.

Recently he has been retained as consulting engineer for the War Department on certain phases of the Pittsburgh Flood Control investigation which the Corps of Engineers is now conducting through the District Office.

NICHOLAS S. HILL, JR., who has been awarded the Thomas Fitch Rowland prize of the American Society of Civil Engineers, for his paper on "The Oradell Dam of the Hackensack Water Co.," is a native of Maryland and a graduate of Stevens Institute of Technology. Upon being graduated he served as a mechanical engineer with the South Side Elevated R.R., Chicago, Ill., and was later engaged to serve as engineer-secretary of the sewage commission of Baltimore, Maryland. He was afterwards appointed engineer of the electrical commission of Baltimore.

From Baltimore Mr. Hill went to Charleston, South Carolina, as chief engineer and general manager of the Consolidated Ry., Gas and Electric Co. of South Carolina. He returned to Baltimore from Charleston to assume the duties of chief engineer of the Baltimore City Water Department. Upon completion of constructive work there he was appointed chief engineer of the Department of Water Supply, Gas and Electricity of New York City. With the above experiences in hand Mr. Hill entered private practice as a consulting engineer specializing in the design, construction and operation of water supplies and sewage disposal works, and public utility valuations.

For the past twenty-five years or more Mr. Hill has acted in a consulting capacity for many municipalities and privately-owned water companies and on various commissions as an expert on water and sewage matters. More recently he served as consulting engineer to the New Jersey State Water Policy Commission, and reported upon the sources of water supply of the state.

For many years Mr. Hill has been the consulting engineer of the Hackensack Water Co. and last year was appointed president.

He is a past-president of the American Water Works Association.

The Collingwood Medal for Juniors was awarded to Cecil Vivian von Abo, for his paper on "Secondary Stress in Bridges." Mr. von Abo is employed in the chief engineer's office of the South African Rivers and Harbors Commission.

A. W. KUTZ, colonel, Corps of Engineers, who was awarded the Arthur M. Wellington Prize, is a native of Reading, Pa., and a graduate of the United States Military Academy in the class of 1893. His first important assignment was that of assistant in the office of the Chief of Engineers in 1903. Subsequently, he served as instructor in practical military engineering at the Military Academy, followed by a tour of duty in Seattle, Wash., in charge of sea-coast fortification and river and harbor work. From 1911 to 1914 he was chief engineer of the Philippine Department and shortly after his return to the United States was appointed Engineer Commissioner of the District of Columbia. Except for the period of the war, he held this position until 1921.

During the World War he was in command of the 13th Engineers, a railway operating regiment, and served as Assistant Chief of Staff, S. O. S. In July, 1918, he was promoted to the grade of Brigadier General and placed in command of the Engineer Replacement Camp, A. A. Humphreys, Virginia.

Since 1921 he has been on duty as Division Engineer, Central Division, which embraces the territory drained by the Ohio River and its tributaries. During the past year, he has been the chairman of the executive committee of the Waterways Division, Am.Soc.C.E.

LEWIS A. PERRY, whose paper on the "Hexagonal Slab Design of Concrete Pavement" won for him the James Laurie Prize, is a native of Fort William, Ontario. His education was limited to rural public school training, so he began early field work in engineering, his first positions being with the Grand Trunk Pacific and the Canadian Northern Railways on location, construction and maintenance-of-way in various capacities up to and including acting resident engineer of construction. From November, 1914, to January, 1919, he served in an infantry battalion of the Canadian Expeditionary Forces, having two years and ten months active service in France of which two years were spent with the Royal Engineers, Technical Service, in the development and use of sound ranging equipment, and concrete construction.

From February 1919 to September 1920 Mr. Perry was employed by the Canadian Government Railways. He

(*Continued on page* 131)

Second Tri-State Delaware River Compact Drafted

Allocation of Part of Flow Between Pennsylvania, New Jersey and New York Made

An earlier draft of the compact or treaty between the states of Pennsylvania, New Jersey and New York for the division of the waters of the Delaware River between those states having failed of approval by New Jersey and New York, the Tri-State Delaware River Commission having the matter in charge, signed a new and considerably revised compact on Jan. 13. Unlike the old compact, the new one plans to go no further for the present than to divide a third of the flow of the stream between the three states and instead of share and share alike, it specifies the total draft for the year that each state may make on the Delaware River. These totals give an average of 900 m.g.d. to Pennsylvania and 600 m.g.d. each to New Jersey and New York. The treaty provides specifically for maintaining a reserve flow in the river and for a permanent Tri-State Delaware River Commission to administer the terms of the treaty, including the approval of any proposed diversion of the waters of the Delaware or its tributaries. This commission will consist of not over three members from each state but only the commissioners from New Jersey and Pennsylvania would pass upon diversions below Port Jervis where the Pennsylvania-New Jersey boundary line begins.

Personnel of Commission

The members of the commission are the same as they were originally; that is, three from each state, except that for New Jersey the seven members of the Water Policy Commission as created by the New Jersey Legislature of 1925 are substituted. The commission was guided by a technical advisory commission of lawyers and engineers representing each of the three states. The engineers for Pennsylvania were Charles E. Ryder, engineer of the Water Resources Board of Pennsylvania and S. M. Swaab, consulting engineer, Philadelphia. For New Jersey there were three engineers: George W. Fuller, Morris R. Sherrerd and Charles F. Breitzke. The engineers for New York state were J. Waldo Smith and Thaddeus Merriman. The two last named, together with Mr. Sherrerd and Mr. Ryder, were advisory engineers in connection with the drafting of the first proposed compact.

The treaty covers the entire drainage basin of the Delaware River from the various head waters to Trenton Falls. It states that the "order of importance and public value of water," under the compact, "shall be: (A) domestic and municipal, (B) sanitation, (C) industry and power, and (D) navigation." Under the compact and subject otherwise to administrative control by law provided under the legislation of the several states, each signatory state may divert water from any tributary of the Delaware River within that state or from the channel, or from both, but in any calendar year not to exceed, for Pennsylvania, 328½ billion gallons; for New Jersey 219 b.g.; and for New York also 219 b.g. The corresponding daily averages are as given above. The quantities stated are "in addition to all quantities of water which have heretofore been lawfully diverted by the normal operation of all works existing and in actual operation within each state in the Delaware drainage basin when this compact becomes effective."

Wherever there is diversion from any tributary of the Delaware "there shall be provided sufficient storage to insure the reserve flows" in the upper and lower basins stipulated in the compact. The upper basin is the district above and the lower basin is the district below Port Jervis, the latter down to Trenton Falls. This reserve flow is thus specified in the compact:

"(3) Within the Upper Basin, at all times during the months of July, August, September and October, there shall be released from storage and delivered into the tributary or into the channel of the Delaware River above the point at which the tributary enters said channel, a reserve flow equal to 0.45 sec.-ft. for each square mile of drainage area above the point of storage; during the remainder of the year such a reserve flow shall be maintained only on the days when the flow from the drainage area above the point of storage is less than 0.45 sec.-ft. for each square mile of drainage area above the point of storage.

"(4) Within the Lower Basin there shall at all times be released from storage and delivered into the tributary or into the channel of the Delaware River above the point at which the tributary enters said channel a reserve flow equal to 0.15 sec.-ft. for each square mile of drainage area above the point of storage."

Reserve Flow

The compact, dealing further with reserve flow, state that subject to schedules prescribed by the permanent commissition each state shall be allowed "at least one-third of the flow over and above the reserve flow requirements in the Upper Basin, while in the the Lower Basin the allowance shall be at least one-half of the flow over and above the reserve flow requirements, New York and Pennsylvania alone being concerned as regards the Lower Basin." Should the permanent commission allow at any time diversions in excess of the divertible flow, as specified, it "shall not operate to create an irrevocable right." The compact contains additional specifications and explanations as to reserve flow and other matters, the building of dams across the Delaware River under terms and conditions to be prescribed by the proposed permanent commission, the measurement of water diverted, etc. It also provides that the signatory states agree to preserve the sanitary qualities of the river by co-operative means and to insure forest cover and fire protection in the drainage basin.

As is the case in all interstate treaties, the one under consideration does not become effective until it is approved by the legislatures of all the states and by the Congress of the United States.

Public Works Bill Drafted by Engineering Council

Chief Work of Annual Meeting Is Plan to Reorganize Engineering of Federal Government

Adoption of a definite legislative program covering public works was the chief accomplishment of the two-day annual meeting of the American Engineering Council held in Washington Jan. 13-14. The assembly of the Council sanctioned a public works measure to be introduced in the House of Representatives by Adam M. Wyant of Pennsylvania. This bill embodies the essential features of the report of the Council's special committee adopted at the last meeting of the administrative board held at Cornell University.

By terms of the proposed bill the name of the Department of the Interior is changed to the Department of Public Works and Domain and thorough provision is made for the reorganization and co-ordination of the federal public works functions. The Secretary of the Interior would by terms of the bill be designated the Secretary of Public Works and Domain.

Other Provisions of Bill

The Wyant bill provides for an assistant secretary and not more than six directors of bureaus of equal rank. The Secretary may at his discretion establish an advisory commission to be known as the Board of Planning and Design, to be composed of representatives of the architectural and engineering staffs of the Department, to give counsel to the Secretary regarding the design and character of important works to be executed by the Department, and to study and formulate plans for the systematic development of federal public works.

The Wyant bill would transfer to the Department of Public Works and Domain:

1—The Bureau of Public Roads, except the agricultural engineering division [now in the Department of Agriculture];

2—Office of the Supervising Architect [now Treasury];

3—Board of Engineers on Rivers and Harbors, and the duties of the Chief of Engineers pertaining thereto, the Mississippi River Commission, the California Debris Commission, Alaska telegraph and cable system, and all other engineering and construction of a civil character [now in the War Department];

4—Office of Public Buildings and Parks of Washington, D. C.

5—Inland Waterways Corporation [War Department].

The bill also proposes that engineering officers of the U. S. Army may be detailed by the Secretary of War to non-military duties having to do with river and harbor improvement, or any other "civil functions," with the approval of the Secretary of Public Works and Domain.

The Assembly authorized the raising of a fund with which to prosecute a nation-wide campaign in support of the Wyant plan.

George Kittredge Retires as New York Central Engineer

George W. Kittredge, chief engineer of the New York Central Lines, Buffalo and East, since 1906 has been retired having reached the age of 70 years. He has been succeeded by F. B. Freeman, whose resignation as chief engineer of the Boston & Albany R.R. was announced in these pages Jan. 6. Mr. Kittredge is a native of North Andover, Mass., where he was born Dec. 11, 1856, and is a graduate of Massachusetts Institute of Technology in the class of 1877. He began his railroad service in 1880 and his service with the New York Central system in 1890 as assistant chief engineer of the Cleveland, Cincinnati, Chicago & St. Louis R.R. In 1891 he became chief engineer of the same road, a position which he held until he was appointed chief engineer of the New York Central and Hudson River R.R., now a part of the New York Central Lines.

Muscle Shoals Plants Bring Net Return of $859,210

The net operating revenues of the Muscle Shoals power plant during the year 1926 amounted to $859,210 according to an announcement of the War Department. From the hydro-electric plant at Wilson Dam, a total of 428,265,855 kw.-hr. of electric energy was sold to the Alabama Power Company under the temporary contract with that company for the sale of power. The following table gives the details of the receipts from the hydro-electric and steam power plants.

Receipts from sale of power, Wilson Dam	$872,617
Maintenance and operation, Wilson Dam	173,777
Net operating revenue, Wilson Dam	698,839
Rental of steam plant under lease of the Alabama Power Co.	120,000
Receipts for power generated in steam plant	40,370
Net revenue from steam plant	160,370
Total net operating revenue, Muscle Shoals plants	859,210

Am. Soc. C. E. Awards Medals and Prizes

(*Continued from page 129*)

then went to the I.C.C., as assistant engineer on valuation work for the O.W.R.R. & N. Co., Portland, Oregon.

In April 1921 he was employed by Long-Bell Lumber Co. (and subsidiary companies) at Longview, Washington, as assistant engineer, conducting topographic surveys and preliminary railway location; and as construction engineer in charge of municipal development, involving 900,000 sq.yd. concrete pavement, some water and sewer main construction and miscellaneous concrete structures. During this work the hexagonal slab design of concrete pavement was developed, extensive studies made of economics of concrete aggregate selection, and water-cement ratio control of concrete mixtures successfully applied in pavement construction.

In July 1926 he was made superintendent of buildings, city of Longview.

Washington Notes

BEFORE reporting to the Federal Power Commission on the upper Tennessee river applications O. C. Merrill, the Commission's executive secretary, is seeking additional data on the amount of power the South may be able to absorb. There is some question in his mind if a market can be found for all the power that would be developed if all the proposed developments are carried out.

IN CARRYING out the provisions of the recently enacted law setting up a separate public utility commission for the District of Columbia, the President has sent to the Senate the nomination of John W. Childress and Benjamin F. Adams to serve with Colonel J. Franklin Bell as members of the new commission. Blaine Mallan was nominated for the post of people's counsel. The law provides that such an office be created in connection with the new plan for handling public utility matters in the District of Columbia. Heretofore the commissioners for the District of Columbia have handled public utility matters in addition to their other duties.

Mr. Childress is the head of the Emerson Pump and Valve Co. He is a native of Tennessee but has lived in the District of Columbia since 1904. Mr. Adams is a native of New Hampshire but was for twenty years an employee of the District of Columbia. Until 1920 he was a member of the board of assessors.

EITHER government or private power development is possible under the revised Boulder Canyon bill, as now before the House of Representatives. Doubt has been expressed by many as to the desirability of government power development, and in the several minority reports submitted to the House by member of the committee on Irrigation and Reclamation the bill is opposed on this ground. The bill, however, gives discretionary authority for power development by the government or by a lessee of the water; in either case the distribution of power beyond the busbars is to be carried out by others than the government.

Under section 6 of the bill the Secretary of the Interior may (1) build a power plant and sell the energy at the switchboard, or (2) build a power house and contract for the lease of a unit or units of this power house to those who are prepared to install machinery and generate electrical energy, or (3) lease the use of the water for power development in the lessee's own power plant. It is expected that upon passage of the bill, the Secretary of the Interior would proceed at once to ascertain which of the three methods of arranging for power generation would be most desirable and would most surely provide the necessary revenue which, together with that obtained from supplying irrigation and domestic water, will make the work self-sustaining and return its cost in fifty years.

Hatton Resigns as Engineer of Milwaukee Commission

T. Chalkley Hatton has resigned as chief engineer of the Milwaukee Sewerage Commission after a service of thirteen years. During the period indicated he conducted experiments on sewage treatment which led up to the adoption of the activated-sludge process for Milwaukee and supervised the design and construction of the plant which was put in operation something over a year ago. During the past few years Mr. Hatton has also been supervisor of design and construction of intercepting sewers for the Milwaukee Metropolitan District, which includes all of the suburbs of Milwaukee except South Milwaukee. It is unofficially reported that after a vacation Mr. Hatton will take up the practice of consulting engineering with headquarters at Milwaukee.

Detroit Asphalt Paving Co. Not Monopoly, Judge Rules

A favorable decision for the Detroit Asphalt Paving Co. has been handed down by Judge Leland W. Carr in the suit brought by the state of Michigan through the attorney general's office charging the paving company with operating so that other firms of a like nature in Detroit could not get business.

Last December Judge Carr of the Ingham County Circuit Court where the case was being tried ordered the attorneys for the Detroit Asphalt Paving Co. and the attorney general to file briefs in the state's quo warranto suit designed to dissolve the alleged paving trust. Officials of the company were indicted some time ago in connection with their paving activities.

Judge Carr held that the company is not a monopoly.

J. D. McArthur, Railroad Builder, Dies at Winnipeg

John D. McArthur, pioneer railway contractor of Western Canada, died on Jan. 10 aboard his special car at Winnipeg, Man. He was 73 years old. Mr. McArthur's experience in Western Canada covered a period of fifty years. He was born in Glengarry, Ontario, and when the big rush to Manitoba began in the seventies he joined it, arriving in Winnipeg in 1879. He first took up small construction contracts on the Canadian Pacific Ry. In 1889 he was awarded the contract to build the Manitoba government railway from Emmerson to Winnipeg. Later on he built 245 miles of railway through the difficult rock-ribbed territory of the Superior Junction section of the Grand Trunk Ry. Besides this work he built about 500 miles for the Canadian Pacific and also was prominent in the building of the Hudson Bay Ry. During the past decade his chief interest was the development of the Peace River country, and he had large railway interests in Alberta, having been president of the Edmonton, Dunvegan, and British Columbia Ry., the Alberta and Great Waterways and the Central Canada Ry.

Personal Notes

SAMUEL T. WAGNER, chief engineer of the Reading Company, has been released from active duty and appointed consulting engineer. He has been succeeded as chief engineer by Clark Dillenbeck, assistant chief engineer. Mr. Wagner is a native of Philadelphia where he was born Aug. 30, 1861, and a graduate of the University of Pennsylvania, class of 1881. From that date until 1893 he was with the Phoenix Iron Co. and from 1894 until 1900 was with the Bureau of Surveys in the city of Philadelphia. In 1902 he went to the Philadelphia & Reading R.R. (now the Reading Company) as engineer in charge of grade crossing elimination. On April 6, 1915 he was appointed chief engineer of the company. In 1915 Mr. Wagner was awarded the James Laurie Prize by the American Sociey of Civil Engineers.

CLARK DILLENBECK was born at Palatine Bridge, N. Y. in 1866 and graduated from Cornell University as a civil engineer in 1888. Two years later he entered the service of the Philadelphia & Reading Ry. as an assistant to the engineer of bridges. Subsequently he was in charge of general building construction, including piers for the United Gas Improvement Co. and several oil companies on the Delaware River, and consulting engineer for the Vulcanite Portland Cement Co. In 1914 Mr. Dillenbeck was appointed engineer of bridges of the Philadelphia & Reading Ry. and in 1919 was appointed assistant chief engineer.

J. A. L. WADDELL, consulting engineer, New York City, announces that he has formed a partnership with his associate engineer, SHORTRIDGE HARDESTY, the organization to have the name Waddell and Hardesty, with offices at 120 Broadway, New York City.

W. HUTABLE, of Lansing, Ark., has been selected as district highway engineer of Crittenden County, Arkansas, and his assistant will be C. H. Bond, of Marion, Ark.

MAJOR L. W. MILLER, military assistant to the United States district engineer at Jacksonville, Florida, has been transferred to a three-year service in the Panama Canal zone. His successor at Jacksonville is LIEUT. E. M. CAFFEY.

W. H. YEO, Las Cruces, N. M., has been appointed state engineer for New Mexico. Mr. Yeo has been in federal reclamation service in several states in the West and was at one time assistant engineer of the Rio Grande project. He also served as an inspector of the New Mexico State Highway Department and as surveyor of Dona Ana County.

W. CHESTER MORSE has been appointed city engineer of Seattle, Wash., to take office Feb. 1. Mr. Morse, who is a hydraulic engineer, went to Seattle in 1882 where he completed his education. Beginning in 1909 he was in charge of street work in Seattle and Portland. He was a member of the engineering firm of Lewis, Wiley & Morse from 1908 to 1917. In war service before he went to France he was an artillery engineer in the coast defense of Puget Sound and in France rose to the rank of major. After the war he was an engineer for the Puget Sound Bridge and Dredging Co. He was in charge of construction of the Ochoco dam at Prineville, Ore., and of the University of Washington stadium in 1921; later he was one of a commission of engineers that made a survey and recommended construction of a dam in Diablo Canyon as part of the Skagit hydro-electric development.

Engineering Societies

Calendar

Annual Meetings

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual Meeting, New York City, Jan. 19-21, 1927.

ASSOCIATED GENERAL CONTRACTORS, Washington, D. C.; Annual Convention, Asheville, N. C., Jan. 24-28, 1927.

ENGINEERING INSTITUTE OF CANADA, Montreal; Annual Meeting, Quebec, Feb. 15-17, 1927.

ASSOCIATION OF HIGHWAY OFFICIALS OF NORTH ATLANTIC STATES, Trenton, N. J.; Annual Meeting, Atlantic City, N. J., Feb. 16-18, 1927.

AMERICAN CONCRETE INSTITUTE, Detroit, Mich.; Annual meeting, Chicago, Ill., Feb. 22-24, 1927.

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago, Ill.; Annual Convention, Chicago, Ill., March 8-10, 1927.

NATIONAL FIRE PROTECTION ASSOCIATION, Boston, Mass.; Annual Meeting, Chicago, Ill., May 9-12, 1927.

The Texas Section of the Southwest Water Works Association announces the ninth "water-works short school" to be held at Dallas, Tex., Jan. 24 to 29 in co-operation with the State Board of Health and the city health department. The Texas Association of Sanitarians, Austin, Tex., has issued the proceedings of the water-works short school of 1926 and also a book on "Applied Municipal Sanitation." H. H. Gowins, Dallas, is city water commissioner, and V. M. Ehlers, Austin, is secretary of the Texas section of the Southwest Water Works Association.

The Engineers Club of Cincinnati has elected as president Edgar D. Gilman, director of the department of public utilities; vice-president, Forrest Cardullo, engineer of the G. A. Gray Machine Tool Co.; secretary, E. A. Gast, county engineer and surveyor. A paper on "Aviation and Airplane Construction," by M. Stout, is on the program for Jan. 25.

The Indiana Engineering Society will hold its 47th annual meeting at the Lincoln Hotel, Indinapolis, Jan. 26 and 27. Charles Brossman, consulting engineer, Indianapolis, is secretary.

Obituary

SIR FRANCIS FOX, an eminent English engineer, died Jan. 7 in London at the age of 82 years. His most noted work was on the Simplon tunnel through the Alps, and he was also known for his work in saving Winchester Cathedral. He was the author of a number of engineering works on tunnel and railway construction.

JOHN R. MCGINLEY died in New York City, Nov. 29, at the age of 75, after an illness of several months. Mr. McGinley was an early associate of George Westinghouse, with whom he formed the Westinghouse Electric & Mfg. Co. and with whom he was associated for many years in the Westinghouse Air Brake Co. Mr. McGinley was president of the Duff Mfg. Co., Pittsburgh, for 25 years, and at the time of his death was a director and chairman of the board of directors of that company. He was a director of Dwight P. Robinson, Inc., New York, and of a number of banks in Pittsburgh. He was for many years chairman of the board of directors of the Chicago Pneumatic Tool Co. and an officer in numerous other industrial institutions of Pittsburgh and elsewhere.

H. WALES LINES, contractor, Meriden, Conn., president of the company of his name, died Jan. 11 at his home in that city, aged 88 years.

THOMAS L. LAWSON, former city engineer of National City, Cal., and more recently assistant engineer for the City of San Diego, Calif., in connection with the construction of the new million-dollar mole pier, died in the latter city Dec. 23.

MILTON H. BRONDSON, commissioner of public works of the city of Providence, R. I., and widely known as a traction engineer died Jan. 15 in San Diego, Calif. He was known best for the rehabilitation of the San Francisco car lines following the great earthquake in 1906. He also built tramway systems in Lyons, France, and throughout the country. He was city engineer of Providence from 1915 to 1924, and during the War, he served in building cantonments in New England.

HORACE A. SUMNER, civil engineer, Denver, Colo., died Dec. 31 at the age of 82 years. Mr. Sumner, at the time Abraham Lincoln was shot, was a young engineer on the Old Colony R.R. in Massachusetts. He went to Colorado in 1886, served as engineer for the Burlington and later on was chief engineer of the Denver & Salt Lake R. R. For two years he was state engineer for Colorado. His son, Robert, who is manager of the Denver water system and his son, Lewis A., is construction engineer for the Standard Oil Co. in Chile.

EDWARD DE LANCEY, of Geneva, N. Y., a civil engineer, who formerly worked for some years on the Croton Aqueduct, died recently, aged 65 years.

Construction Equipment and Materials

A Section Devoted to What the Manufacturer is Doing for the Engineer and Contractor

New Equipment for 1927 at Road Show

Exhibits of 305 manufacturers show new models of construction equipment to 25,000 engineers and contractors

A CONTINUATION of the remarkable growth of the Road Show held annually in conjunction with the American Road Builders' Association Convention, was recorded in Chicago during the week of Jan. 10-14. In 1926 there were 288 exhibits; this year there were 305. This increase was possible because of an increase in space from 79,000 to 85,000 sq.ft. and also from a cutting of the space allotted to some of the older and larger exhibitors. As usual, there was about twice as much space applied for as was available. Registration at the Road Show totaled approximately 25,000 as compared with 20,000 in 1926. Charles M. Upham served as general manager of the Show.

Especially noticeable at the 1927 Show were the many small motion picture machines which were used by the various manufacturers to show their equipment in actual operation. Other manufacturers maintained a working exhibit on vacant lots in the vicinity of the Coliseum, in which the convention was held.

In addition to the many types of equipment shown, the Mexican National Commission of Roads maintained an exhibit consisting of motion pictures especially prepared to give an idea of the activity now under way on the Mexican road program. The Bureau of Public Roads had a large and instructive exhibit, featuring charts and statistics, results of investigations and suggestions about highway building, maintenance and operation.

Before considering the detailed features of the various machines, a few general observations may be made as a result of an inspection of the equipment at the Show.

Trend of Improvements

THE TYPES of equipment shown at this year's Road Show tended to be more inclusive than formerly. In fact, it would probably be better described as a Construction Show rather than a Road Show. Examples of equipment exhibited that is ordinarily not associated with road building activities were material elevator towers, small electric lighting plants, many types of hoists, pile drivers, saw rigs and woodworking machinery.

Developments are most noticeable in lubrication, bearings and machine materials. Enclosed gears running in oil are becoming commonplace. Pressure oiling systems have practically displaced the old turn-down oil cup. An improved spring oil cup was shown designed for even and automatic feed, filling being by means of a pressure gun. Probably the most advanced lubrication refinement shown was the "one shot" system. By means of this system a pull on a lever on the operator's platform automatically oils every bearing on the machine.

The utilization of roller and ball bearings has shown a phenomenal acceptance. Over 50 per cent of the machines exhibited used such bearings in whole or in part. Most other bearings are bronze bushed and the majority of them are split type for easy adjustment and repair.

Steel castings have increased in use especially on the larger and heavier equipment replacing riveted steel and cast iron. This trend has been noticeable for the past three years, taking a turn this year towards the use of very large castings of the so-called unit construction. Thus the whole frame, the bearing arms, gear cases and similar units each are cast in one piece designed to give longer life and to assure a better and more permanent alignment of the moving parts.

Speed and operating comfort have been major objectives. All controls are located within easy reach of the operator who is provided a comfortable seat whenever it is possible. A two-speed hoist was shown having two sets of gearing on one drum so that slow speed and high power or high speed with less power are both available. Motor truck manufacturers are giving thought to the specific needs of the highway contractor designing their trucks to meet his requirements. Rapid and clean dumping bodies are the rule. A body that dumps to either side or to the rear was an unusual development shown.

Development of the huge 27-E concrete pavers has been especially active. These machines are complete power plants with all the necessary refinements in mechanism, designed to withstand misuse and hard service. Larger openings at both the charging and discharging ends of the drums speed up the work by getting the materials into and out of the mixer in minimum time. Splash and pressure lubrication shows quite as much refinement as it does on stationary equipment. New water supply systems, most of them designed on a siphonic principle, give extremely accurate control of water in line with the present stress being placed on the water-cement ratio in concrete mix design. Large diameter pipes and straight flow from the water tanks to the drum are helping to speed up the paver output. Proportioning aggregate by weight has been made more accurate and more efficient by the use of dial scales instead of the older lever arms since the dial is more visible and moves more slowly. Refinements are also being carried down to the 7-S and 10-S mixers making them comparable in quality to the large pavers.

Heavier tractors are being designed to handle the larger graders and snowplows which the demand for increased output and speed is causing to be built. Small tools such as hand shovels are being made of special steel and of reduced weight.

The foregoing gives only a general idea of the major and important trends. The following notes will consider the different types of equipment and materials in more detail, although space limitation makes it impossible to give any considerable mention to many of the machines, which, while extremely important, and interesting, are so well known that a detailed description is not necessary.

Power Shovels and Cranes

POWER shovel and crane developments were in the line of improved details, rather than in any radical changes in design as occurred last year in the use of air engines, and air-operated clutches. However, the Star Drilling Machine Co. exhibited a 3-yd. power shovel on which no dipper stick is used. The dipper is rigidly attached to the end of the boom which is a telescoping rack, moving into and out of the body of the shovel as the dipper is crowded into the material. A ditcher pull shovel attachment is also available which may be adapted to backfilling work. The machine is powered either by gasoline or electricity.

The Erie Steam Shovel Co. exhibited the gas-plus-air shovels introduced last year, in which the crowding and swinging engines are operated by air, leaving the main gas engine for propelling purposes and for operating the air compressors. This company also exhibited a 1-yd. steam machine, developed in the past year in place of the ¾-yd., on which something over 100 improvements have been made in the various details.

The Thew Shovel Co. exhibited, in addition to its 75-hp. 1¼-yd. machine, a new 1-yd. machine similar in every way except dipper capacity, power plant, power takeoff and counterweight. Harnischfeger Corp. featured a 1-yd. shovel with gasoline motor and a ½-yd. machine equipped with a Diesel engine. Both of these machines incorporated the companies' new unit cast-steel construction in which the car body, the

revolving frame and the side frames are each made in single pieces. Both of these machines have an extremely short tail plane for work in cramped spaces. A ¾-yd. shovel skimmer scoop, a truck crane and a dragline were shown on an adjacent vacant lot. Northwest Engineering Co. exhibited a gasoline shovel, a Diesel shovel and a gasoline crane. Its 4-cylinder Diesel engine, designed especially for power shovel and crane work, was a feature of the exhibit. Link-Belt Co. showed for the first time its 1½-yd. all-purpose crawler crane, using oversized brakes, clutches and drum, especially designed for extremely hard work. Industrial Works exhibited a new 1½-yd. gasoline shovel, in place of its older ¾-yd. machine. Special self-cleaning driving gears are used on the new model. The Koehring ¾-yd. gas shovel used a new power dipper trip and a larger power plant than last year.

A gasoline-electric shovel in a 1-yd. capacity, was shown by the Marion Steam Shovel Co. There are no clutches on the machine, an independent drive being used for each movement. The operation of the series motors is claimed to approximate closely the flexible characters of the steam shovel. The machine is convertible to dragline or crane. The company also exhibited a 1-yd. steam shovel. The Osgood Co. exhibited its 1¼-yd. gasoline crane with a new enclosed gear drive truck, permitting flexible handling of the machine. Different gear arrangements permit the shovel to turn in a wide circle or to turn in its own length by having the crawlers run in opposite directions. Brown Hoisting Machinery Co. exhibited its gas shovel crane with a ½-yd. clamshell. Orton Crane & Shovel Co. showed both a ¾-yd. gasoline crane and a ½-yd. gasoline shovel. Russell & Co. exhibited a 1¼-yd. gasoline shovel, and Speeder Machinery Co. featured a gasoline shovel with a ½-yd. bucket and a completely enclosed steel cab.

The smaller skimmer scoop type crane and convertible cranes and shovels were shown with many improvements. The Insley Manufacturing Co. showed its shovel equipped with a new steel cab. The Keystone Driller Co. featured a totally enclosed steel cab on its gas crawler excavator, also equipped with a ⅝-yd. skimmer bucket and an electric trip. Pull stroke and ditcher buckets, all with electric trip, were also shown for attachment to this machine. Bay City Dredge Works exhibited its new ¾-yd. skimmer-ditcher machine introduced during the past year with full crawler treads and a heavy riveted steel construction. The company also exhibited a new crawler tractor shovel built around the McCormick-Deering tractor; a ⅜-yd. bucket is used. Byers Machine Co. showed its Bear Cat machine with shovel attachment. A Fordson push shovel was shown by the Blair Manufacturing Co. consisting of a detachable A-frame unit to which the dipper stick is attached. The shovel is crowded into the material by movements of the Fordson. Another Fordson shovel was shown by the Universal Power Shovel Co., with operation similar to that of a conventional power shovel. Other shovel companies exhibiting were the General Excavator Co. and the Bucyrus Co. Universal Crane Co. exhibited a new 6-ton crane with a 24-ft. steel boom and a 16-ft. steel extension, mounted on a 5½-ton Mack truck. A machinery crab crane, equipped with a new ½-yd. pull shovel, and a 36-ft. boom for high lift work, was also exhibited.

Grading Machinery and Dump Wagons

GRADING EQUIPMENT and dump wagons were exhibited by eighteen manufacturers. Motor graders for patrol maintenance purposes were especially numerous. Several graders with especially high blade lifts were shown for high bank grading and cutting purposes. The Ryan Manufacturing Corp. featured a motor controlled grader having a separate power plant for operating the leanable frame and the high-lift blade. A model of the machine was shown while one of the graders was kept in operation on an adjacent vacant lot. Galion Iron Works & Manufacturing Co. exhibited a new leaning wheel grader using a new pivot frame adjustment to serve the same purpose as the usual side shift mechanism. Motor graders built around both the McCormick-Deering and the Fordson tractors were exhibited by Austin-Western Road Machinery Co., Gilbert Manufacturing Co., Wehr Co., Shaw-Enochs Tractor Co., Russell Grader Manufacturing Co., Good Roads Machinery Co., Inc., and the Hadfield-Penfield Steel Co. All of the machines were either regularly or optionally equipped with rubber tires. The Shaw-Enochs grader was designed to drive the tractors much as a horse would be driven from the wagon, the operator having a seat on the grader at the rear. The other graders were built around the tractors. The Wehr Co. also exhibited a new Fordson truck-tractor with a 1-yd. gravity dump body, the whole mounted on three rubber-tired wheels. The operator's seat is over the single rear wheel, the body dumping directly forward.

A new street excavator similar to an elevating grader but dumping over the end instead of to the side was one of the most interesting exhibits. It has a self contained power plant for propelling it and a smaller power plant for operating the belt conveyors. It takes up a width of only 7 ft. and is thus especially adaptable for alley or congested street work.

A new high-lift grader with 6½, 8 or 12-ft. mould boards, weighing 4,500 lb., and a 12 to 14-ft. mould board grader weighing 11,000 lb. made up the exhibit of the Rome Mfg. Co. The Klauer Manufacturing Co. exhibited a road maintainer consisting of a structural steel frame mounting for two tandem arranged scraper blades. J. D. Adams & Co. exhibited a 12-ft. leaning wheel grader, upon which a new improvement in the form of machined ball and socket split bearing joints is used in the blade lift mechanism. This is claimed to eliminate all lost motion and to assure rigidity of the cutting blade. This company also showed a road maintainer consisting of a structural steel frame, upon which were mounted a total of 40 ft. of scraper blades. This machine is for trailer attachment to a tractor.

Motion pictures of a self-loading dump cart equipped with a plow, were shown by the Andrews Manufacturing Co. The Little Red Wagon Manufacturing Co. exhibited an elevating grader and its line of dump wagons. Dump wagons were also shown by Streich & Brothers Co. and the Miami Trailer Scraper Co., while the Wiard Plow Co. shower an entire line of road-building plows including a combination rooter and furrow plow. Other road-grading machinery exhibitors were the Acme Road Machinery Co., and the Northfield Iron Co.

Road Rollers

ROAD ROLLERS in 5-ton sizes were most common at the show. Galion Iron Works & Manufacturing Co., however, showed, in addition to its 5-ton internal gear drive roller, a 10-ton, four-cylinder, motor roller. The Huber Manufacturing Co. also showed its 10-ton motor roller and a new 5-ton, four-cylinder motor roller, both of which are completely enclosed in steel housings. Austin-Western Road Machinery Co. exhibited a small Fordson roller with planer and scarifier, as did the Wehr Company. A feature of the Wehr Fordson roller was the fact that it could be converted to 3, 4 or 5-ton sizes by bolting weights to the rear wheels. Good Roads Machinery Co., Inc., exhibited a Fordson roller with scarifier and planer, while the Perforated Roller Works exhibited a small perforated roller for rolling the water out of freshly laid concrete. Buffalo-Springfield Roller Co. also exhibited.

Scrapers and Fresnos

FOR EARTH-MOVING, for finishing sub-grades and for earth-road maintenance, a large number of machines were exhibited. The Miami

Road Show Report, Part II, Will Appear Jan. 27

BECAUSE of the extent and interest of exhibits at the Road Show, it is impossible to cover them all in review in this issue. In these pages, then, is to be found the first part of the review. The second will be published in this section Jan. 27. Equipment and materials shown at the Road Show still to be described are:

Snow-fighting Equipment
Street Sweepers and Flushers
Engines
Drag Buckets
Compressors and Air Equipment
Motor Trucks, Bodies and Body Hoists
Tractors and Trailers
Traffic Control Equipment
Accessory Equipment
Pipe
Materials
Small Tools
Miscellaneous

Trailer Scraper Co. featured a one-man power scraper, operated by a power winch, connected to the tractor power takeoff. One-yd. wheel scrapers, equipped with roller bearings and using both welded and riveted construction, were exhibited by the Euclid Crane & Hoist Co. This company also showed a rotary fresno. The Baker Manufacturing Co. exhibited a 1¼-yd. self-loading tractor scraper and several sizes of one-man rotary scrapers. Rotary fresnos were also exhibited by the Perry Co., the Western Wheeled Scraper Co, and the Gustav Schaefer Wagon Co. Edward J. Jackaboice exhibited a road planer attachment for motor trucks. Lakewood Engineering Co. showed a steel sub-grader adjustable to width and a grade rooter. Hydraulically operated bulldozers for Caterpillar tractor attachment were shown by the La-Plant Choate Manufacturing Co. The Avery Power Machinery Co. exhibited a road maintainer designed so that the blade may be operated between the two rear wheels to eliminate side draft on the front wheels. Scarifier attachment is included and the machine is built complete by the company especially for maintenance work.

Concrete Mixers

MUCH ATTENTION has been paid during the past year to the development of large concrete pavers. This was especially evident at the show where a number of these large 27-E machines were exhibited. Five manufacturers featured 27-E pavers in their exhibits, each having special refinements. On the T. L. Smith machine the "one shot" lubrication system is used. By merely ushing a plunger on the operator's platform, every bearing on the machine is oiled. The crawlers on the Koehring paver may be reduced in width from 90 to 82 in. for use on different width pavements. All of the high-speed gears on this machine are located in an enclosed case and the water supply system features straight flow from the tank to the drug through a 3½-in. pipe. A power derrick with friction clutch control is a special feature on the machine for handling batch boxes. An automatic skip guard has been added as a safety feature to keep people from walking beneath the raised skip. Special attention has been paid by the Chain Belt Co. to create extremely fast mixers, getting the materials into and out of the drum in a minimum of time. In fact, this has been a paramount problem to which all of the concrete manufacturers have applied themselves during the past year. A folding top frame which can be lowered in about 15 minutes is a new feature of the Chain Belt machine. Extremely accurate water control is possible by means of a new water supply system. An anticipating governor is used on the engine, so that the engine is speeded up and the power increased while the skip is being raised. The Foote Company, Inc., featured its 27-E paver entirely equipped with roller bearings and special lubrication system. The 27-E paver of the Ransome Co. featured extra heavy construction with oversize shafts and heavy materials.

A 21-S mixer designed for central mixing plants with an overhead operating platform, power operated chute and roller bearing mounting for the drum was featured by the Marsh-Capron Co. This company also showed a 7-S mixer mounted on a cross-wise truck for alley paving and curb and gutter work. This is equipped with rubber tires. Jaeger Machine Co. featured a working model showing its latest development, an automatic skip shaker which is claimed to get all of the material into the drum without hitting the skip with a sledge hammer. The 10-S mixer of the Knickerbocker Co. has been improved by the use of larger drum openings for charging and discharging. All shafting is made of ground and polished steel and split boxings are used on all bearings. Chain Belt Co. also exhibited a new 10-S mixer with a ¼-in. pressed steel track and drumhead in one piece. Orr & Sembower, Inc., exhibited a new 7-S mixer with electric welded drum and frame and a 3½-tilter mounted on rubber-tired trailer. Standard Scale & Supply Co. featured a 7-S power loading concrete mixer, mounted on rubber-tired roller bearing wheels.

Small mixers and plaster machines were shown by the Talbot-Flood Manufacturing Co., the Kwik-Mix Concrete Mixer Co., John Lauson Manufacturing Co., Atlas Engineering Co., and the Knickerbocker Co. Other concrete mixer manufacturers exhibiting included the Leach Co., the Construction Machinery Co., the Ideal Concrete Machinery Co. and the American Cement Machine Co.

Asphalt Paving Equipment

EQUIPMENT, both for constructing maintaining asphalt pavement was exhibited. Pressure distributors were shown by the Kinney Manufacturing Co., E. D. McEtnyre & Co., Inc., Charles Hvass & Co., Inc., and the Barrett Co. The Hvass company also exhibited a chip spreader, consisting of a bin, power unit and rotary pan spreader mounted on a motor truck. This unit can also be used for sanding icy hills. The Etnyre asphalt distributor has been improved by using all clamp connections instead of screw connections on the hose. The Good Roads Co., Inc. exhibited a new type of mechanical stone spreader which is trailed behind a motor truck distributing the stones and chips by centrifugal force. It will spread from 15 to 20 ft. wide and has a capacity of 5 to 50 lb. per square yard.

Complete asphalt repair plants were exhibited by Littleford Bros. and by the Chaussee Oil Burner Co. The Chaussee asphalt repair plant is self-propelled and operated. It is mounted on rubber-tired wheels, having capacity of 200 sq.yd. of 2-in. top per eight-hour day. It carries its own bin storage and the heat is so arranged that the material may be used 45 min. after the burners are started. Littleford Brothers also exhibited an oil burning tar and asphalt kettle which has been improved by submerging the compressor pump, thus eliminating leaky joints.

Aggregate Handling Equipment

EACH year seemingly experiences more active developments in the field of aggregate handling equipment. Bucket and belt conveyors are improved, steel bins and hoppers are developed, proportioning by weight and by volume and the use of inundation extend their uses and new models of crushing and screening plants are brought out. This was true of the past year. George Haiss Manufacturing Co., Inc., Barber-Greene Co. and Link-Belt Co. exhibited bucket loaders. The Haiss loader featured a collapsible platform mounting which gives the machine an overhead clearance of about 10 ft. when being transported. Belt conveyors, both stationary and portable, were exhibited by the Chicago Automatic Conveyor Co., the Burch Plow Works Co., and the Northern Conveyor and Manufacturing Co.

Gravel-handling equipment and models of screening and crushing plants were exhibited by the Russell Grader Manufacturing Co. and the Morrow Manufacturing Co. In the field of bins and batchers, a new 105-ton portable bin was exhibited by the Heltzel Steel Form & Iron Co. This bin was bolted on the center line, breaking down into two units, each consisting of half the tower and half the bin and each mounted on steel-tired wheels. This company also exhibited a new volumetric batcher adjustable by a hand wheel device. A new weight batcher was also shown, sand and stone being placed in separate compartments, the bin featuring a two-point suspension for greater weighing accuracy. The company believes that the bins are designed so as to make their weight determination completely automatic. Blaw-Knox Co. exhibited a 72-ton, two-compartment, portable, self-cleaning bin and a complete mechanical pro-

New Distributor Branch

Hunter Machinery Co., Milwaukee, announces plans for the formation of a new company to be known as the Hunter Machinery Co. of Michigan with headquarters at Grand Rapids. A new office, warehouse and shop building has been completed and was opened for business Jan. 2, 1927. Bert E. Uebele, who has been with the company a number of years, is in charge of the Grand Rapids office. Tom G. Abrams will be in charge of the Flint territory, Leon Lutz, of the Jackson territory, and George Swart will be assistant to Mr. Uebele at Grand Rapids. A complete line of machinery and equipment will be stocked as well as complete parts for repair service. George A. Cooper and Bert E. Uebele also have been made directors in the Wisconsin corporation, whose capital stock has been increased to $100,000. Andrew Crowley, formerly with the Sullivan Machinery Co., has joined the Wisconsin organization to take over the territory formerly handled by T. G. Abrams. Alvin H. Jensen and Ray Arndt, Milwaukee, have been added to the sales force of the Wisconsin corporation.

portioning plant, the cement being weighed, the sand inundated and the stone and sand proportioned by volume. An excess water tank was also used, adjustable for any water-cement ratio. A large two-yard inundator was exhibited and also a small portable inundator mounted on a buggy-type frame. A new machine for automatically injecting calcium chloride solution into the mixer was exhibited. Other companies exhibiting bins included the B. F. Johnson Co., The Butler Bin Co., the Erie Steel Construction Co., and the James B. Seaverns Co.

Finishing Machines and Road Forms

TWO MACHINES for mechanically finishing concrete pavement were exhibited. The Lakewood Engineering Co. featured its machine with a 12-in. screed, a tamper using from 25 to 40 strokes per minute, operated by a roller bearing, heat-treated transmission gear and utilizing spring suspension for the transportation wheels, and a belt. The company exhibited road forms for mechanical finishing, which have been improved during the past year by the addition of stake pockets. The Ord concrete road finisher exhibited by A. W. French & Co. uses a screed and belt. The machine has two working members, a front and a rear screed but utilizes no tamper. The Concrete Surfacing Machinery Co. exhibited a new air-driven concrete surface finisher, a hand-tool designed to smooth set concrete surfaces.

Road forms were exhibited by Heltzel Steel Form & Iron Co., the Blaw-Knox Co. and the Metal Forms Corp. The latter company exhibited a new curb and gutter form, utilizing a double face rail construction to which the fillet member is attached by clamps for rapid erection and dismantling.

Trench Excavators, Cableways and Backfillers

CABLEWAY EXCAVATORS are much too large for exhibit but lend themselves well to working models. Sauerman Brothers featured two working models, one a slack line cableway excavator and the other a power drag scraper. The slack line cableway excavator was shown working in a gravel pit, carrying the gravel to a screening plant. The scraper model illustrated the manner in which this equipment is used for stripping, making cuts and fills, and for grading. The R. H. Beaumont Co. also exhibited a model cable-drive scraper system. The trench excavator of the Austin Machinery Corp. and its standard backfiller were exhibited in the Coliseum while the Harnishfeger Corp. showed its trenching machine on an adjacent vacant lot. A new backfiller designed for light crane work, utilizing a full circle swing and an adjustable boom length was exhibited by the Buckeye Traction Ditcher Corp.

Hoists

IN LINE with the tendency toward multiple-speed hoists, the S. Flory Manufacturing Co. exhibited a new gas-driven double-drum hoist with two sets of gearing and two frictions on the front drum thus making it adaptable to two speeds. It is designed for slack line cableway work or for erection where both light and heavy loads are to be hoisted. This company also exhibited a 20-hp. single drum gasoline hoist with bed plate machined for a second drum attachment. The Clyde Iron Works & Sales Co. exhibited a 15-hp. two-drum hoist, a 35-hp. two-drum hoist with a detachable reversing elevator sheave operating by an enclosed silent chain drive and a 60-hp. three-drum hoist. This company also showed an electric capstan car puller, totally enclosed and weather-tight. A 35-hp. double-drum hoist was also exhibited by Orr & Sembower, Inc.

Manufacturers and Trade Associations

Calendar

Annual Meetings

COMPRESSED GAS MANUFACTURERS' ASSOCIATION, New York; Annual Meeting, New York, Jan. 24, 1927.

AMERICAN WOOD PRESERVERS' ASSOCIATION, Chicago; Annual meeting, Nashville, Tenn., Jan. 25-27, 1927.

NATIONAL ASSOCIATION OF RAILROAD TIE PRODUCERS, St. Louis; Annual meeting, Nashville, Tenn., Jan. 27 and 28, 1927.

HOLLOW BUILDING TILE ASSOCIATION, Chicago; Annual meeting, Chicago, Feb. 10 and 11.

COMMON BRICK MANUFACTURERS ASSOCIATION, Cleveland; Annual meeting, Chicago, Feb. 21-26, 1927.

NATIONAL BATTERY MANUFACTURERS' ASSOCIATION, New York; Annual meeting, Philadelphia, March 11 and 12, 1927.

CONCRETE REINFORCING STEEL INSTITUTE, Chicago; Annual Meeting, White Sulphur Springs, West Va., March 21-23.

HYDRAULIC SOCIETY, New York; Annual meeting Chicago, March 25, 1927.

WATERWORKS MANUFACTURERS ASSOCIATION, New York; Annual meeting, Chicago, June 6-10.

Crushing and Screening Plants

LIKE THE cableways, a crushing and screening plant does not lend itself for exhibition purposes but may be quite effectively shown by models. The Smith Engineering Works had a complete crushing plant consisting of two crushers, two screens, an elevator, belt conveyor and bin, and also a complete gravel-washing plant; these were both in operation. The Williams Patent Crusher & Pulverizer Co. showed one of its Jumbo crushers designed to reduce man-size stone to ¾-in. sizes. This machine is belt driven with a flywheel on the opposite end of the pulley shaft. Three heavy jaw crushers, all belt driven, were exhibited by the Universal Crusher Co. The Morrow Manufacturing Co. also showed a working model of rotary sand and gravel screening plants, a feature of which is that it is completely shop-assembled for shipment.

Vibrating screen of various designs were shown, many of them in operation. The Simplicity Engineering Co. showed a three-bank screen with electric motor fastened to the side frame, and direct-connected to the eccentric shafts. Traylor Vibrator Co. featured a vibrating screen on which no gears, chains, or bearings are used. The vibratory motion is imparted to the screen by electric magnets. Deister Concentrating Co. exhibited a motor-driven vibrating screen and E. C. Jensen showed a model gravel screen separator.

Pumps

HIGH-CAPACITY, triplex pumps and a large combination lift and force trench pump featured the pump display. The Domestic Engine & Pump Co. exhibited a new triplex pump of extra heavy construction, utilizing a force-feed oiling system, roller bearings and designed for pressures up to 500 lb. The unit was mounted on a spring suspension trailer, together with its gasoline engine power unit. Novo Engine Co. exhibited a new line of triplex, duplex and single-acting self oiling pumps. These pumps were mounted on a welded steel truck and powered by the company's 4-cyl. engine. Pumps are fully enclosed and outside packed. The Barnes Manufacturing Co. also featured a triplex which has recently been increased to a capacity of 80 g.p.m., and for pressures up to 500 lb. This company also exhibited a duplex plunger trench pump, a single 4-in. enclosed diaphragm pump and a direct-connected centrifugal pumping outfit. The C. H. & E. Manufacturing co., Inc., recently improved its 80 g.p.m. triplex pump by the use of heavier frame and axles and wider base wheels. A clutch has also been added between the engine and the pump. A high pressure centrifugal pumping set for 25 g.p.m. against a 700-ft. head was shown by the Universal Motor Co.

A trench pump with rubber ball valves and with both a lift and force action, designed to pump 250 g.p.m. against a maximum head of 50 ft., was exhibited in a 4-in. size by the Humphreys Manufacturing Co. This company also exhibited a direct-connected centrifugal pump for drainage work and a diaphragm pump. Ralph B. Carter Co. exhibited a contractor's pump featuring totally enclosed, running in oil gears and bearings. These pumps use rubber ball valves and removable bushings. The American Steam Pump Co. exhibited a Barton centrifugal pump attached to the front end of a Ford engine. A 4-in. diaphragm trench pump, mounted on steel chassis and driven by a gasoline engine was exhibited by the Standard Scale & Supply Corp. A. S. Marlow showed a new 4-in. open discharge diaphragm pump and a 4-in. diaphragm force pump with ball valves.

* * *

[The second and concluding part of this review of Road Show equipment will be published Jan. 27.—EDITOR.]

Business Side of Construction

Facts and Events That Affect Cost and Volume

Improvement Bond Sales Near Record Total

State and municipal bond disposals for December, according to the *Commercial and Financial Chronicle*, aggregated $143,247,896. This came pretty close to the record month of the year, February when $146,915,060 were issued.

The grand total for 1926 is $1,329,074,892—the sixth successive year in which over one billion dollars worth of bonds have been sold by states and municipalities. Besides the long-term borrowings, $608,534,019 temporary municipal loans were negotiated during 1926.

The largest issue disposed of during December was $20,000,000 Port of New York Authority bonds. The following come next in order of size; seven issues of Los Angeles bonds aggregating $15,700,000; two issues of State of North Carolina bonds aggregating $10,000,000; eleven issues of San Antonio, Texas bonds aggregating $3,600,000; thirteen issues of Houston, Texas bonds aggregating $3,112,000.

This Week's Contracts—Week Ago—Same Week Last Year

THE money value of contracts reported in the present issue of *Engineering News-Record* is here compared with the figures for corresponding weeks. Minimum costs observed are: $15,000 for water-works and excavations; $25,000 for other public works; $40,000 for industrial and $150,000 for commercial, educational, religious and other buildings. Under the head of excavations are included drainage, irrigation, levee, river and harbor projects.

Money Value of Contracts Let—Entire U. S.

Week Ending	Public Work	Private Work	Total Contracts
Jan. 20, 1927	$18,672,000	$30,042,000	$38,714,000
Jan. 13, 1927	24,540,000	22,872,000	47,412,000
Jan. 21, 1926	11,379,000	39,472,000	50,851,000
Heaviest Week			
1926, Mar. 11	13,029,000	73,613,000	86,642,000
1925, Sept. 3	16,215,000	69,424,000	85,639,000
Jan. 1 to Date			
1927	49,399,000	80,126,000	127,525,000
1926	52,741,000	99,470,000	152,211,000

A LIST OF REPRESENTATIVE PUBLIC IMPROVEMENT BONDS ISSUED IN VARIOUS PARTS OF THE COUNTRY DURING THE LAST MONTH

State	Purpose	Amount	Rate per Cent	Sold For	Basis	Dated	Maturity	Purchased by
California	Reclamation	$7,133,000	..	100	....	July 1	1934–43	Suttin Basin Co.
Michigan	Roads	261,000	4½	100.51	4.66	.....	1929–37	Detroit Trust Co. of Detroit
		267,000	4½	100.43	4.67	.....	1929–37	Citizens Commercial & Savings Bank of Flint
New Jersey	Roads	3,000,000	4¼	102.85	....	.....	.....	Trust Co. of New Jersey and others
North Carolina	Highway	5,000,000	4¼	100	....	Jan. 1	1930–51	First National Bank of New York and others
	School	5,000,000						
County								
Arlington, Va	Water	540,000	4½	100	....	Dec. 1	.....	Guaranty Co. of New York
Berrien, Mich	Road	104,609	4½	100.14	....	.....	.....	Joel Stockard & Co. of Detroit
Clearfield, Pa	Bridge	125,000	4½	101.56	4.28	Oct. 15	1951	A. B. Leach & Co., Inc., of Philadelphia
Cook, Ill	Hospital	297,000	4	98.81	....	.....	.....	W. A. Harriman & Co. of New York and others
Essex, Mass	School	10,000	4	100.25	3.83	.....	1927–28	Merchants National Bank of Salem
Gallatin, Ky	Road	40,000	5	.....	....	Jan. 1	1933–55	Weil, Roth & Irving Co. of Cincinnati
Hamilton, O	Improvement	184,911	4½	100.37	4.43	Nov. 1	1928–37	William R. Compton Co. of Chicago
Hancock, Miss	Seawall	500,000	5½	101	....	.....	.....	Whitney-Central Trust & Savings Bank of New Orleans
Henry, Ind	Road	42,000	4½	102.50	....	.....	1-10 yrs.	Fletcher Savings & Trust Co. of Indianapolis
Jefferson, Kan	Road Improvement	130,000	4½	101.50	....	Oct. 1	1936	Colombian Title & Trust Co. of Kansas
Lexington, S. C	Road	300,000	4½	100.116	4.70	.....	1928–31	William R. Compton Co. of St. Louis and others
McKinley, N. M	Highway and Road	200,000	5	100	....	Aug. 1	1956	Bosworth, Chanute & Co. of Denver
Madison, Miss	Road	38,000	4½	100.63	....	.....	1-20 yrs.	Merchants Bank & Trust Co. of Jackson
Mahaska, Ia	Road	150,000	4½	100.48	4.44	Nov. 1	1929–41	Harris Trust & Savings Bank of Chicago and others
Middlesex, Mass	Bridge	38,000	4	100.246	....	Dec. 1	1927–31	Paine, Webber & Co. of Boston
Monroe, Fla	Road	500,000	5½	95	5.92	Jan. 1	1936–54	Marx & Co. of Birmingham
	Bridge	25,000						
Montgomery, Ind	Road	48,000	5	100	....	.....	.....	Townsend Scott & Sons of Baltimore and others
Oldham, Ky	Bridge	145,000	4½	.....	....	Nov. 1	1948–54	Rogers Caldwell & Co. of New York
	Road	100,000	4½	.....	....	Nov. 1	1941–48	
Putnam, Tenn	Highway	80,000	5	.....	....	Nov. 1	1956	Rogers Caldwell & Co. of New York
Spartanburg, S. C	Paving	500,000	4½	100.031	4.49	Jan. 1	1930–39	William R. Compton & Co. of New York and others
Washtenaw, Mich	Road	30,500	4½	.....	....	.....	1-5 yrs.	Detroit Trust Co. of Detroit
Township								
Baker, Ia	School	18,000	4½	100.39	4.43	.....	1927–38	George M. Bechtel & Co. of Davenport
Bethlehem, Ind	School	3,500	..	100.78	....	.....	.....	Twelve-Mile State Bank
Center, Ind	School	38,800	4½	100.84	....	.....	.....	Fletcher Savings & Trust Co. of Indianapolis
Newberry, O	Road improvement	2,912	5½	100.10	5.48	Dec. 1	1927–36	Chagrin Falls Banking Co. of Chagrin Falls
Raleigh, N. C	School	400,000	4¼	102.609	....	Dec. 1	1927–56	A. B. Leach & Co. of Chicago
Municipal								
Akron, N. Y	Sewer	179,000	5	105.399	4.48	Jan. 1	1932–51	Manufacturers & Traders Trust Co. of Buffalo
Asheville, N. C	School	1,500,000	4¼	102.179	4.58	Dec. 1	1928–66	William R. Compton Co. of St. Louis and others
	Water	500,000						
	Street Improvement	1,000,000						
Auburndale, Fla	Street Improvement	130,000	6	95	7.17	Dec. 1	1927–36	E. P. McMakin Co. of Chicago
Brighton, N. Y	Water System	12,000	5	104.039	4.51	Nov. 1	1931–42	Sage, Wolcott & Steele of Rochester
Burlington, Vt	School	115,000	4½	102.83	4.30	July 1	1941–55	Harris, Forbes & Co. of Boston
	Street Improvement	50,000						
Conway, S. C	Water Works	30,000	5½	102.88	5.25	Oct. 1	1931–60	South Carolina National Bank of Charleston
Gainsville, Fla	City Building	50,000	5½	100	....	July 1	1936–75	John Nuveen & Co. of Chicago
	Fire Department	50,000						
	Street Paving	70,000						
	Water and Light Impvt	200,000						
Gardiner, N. Y	Building	4,000	4½	100.51	4.63	Aug. 1	1930–33	Ulster Co. Savings Institution of Kingston
Gardner, Mass	School	180,000	4	100.58	3.91	Dec. 1	1927–41	E. H. Rollins & Sons of Boston
Greensburg, Pa	Improvement	100,000	4¼	101.39	4.14	May 1	1931–56	R. M. Snyder of Philadelphia

Weekly Construction Market

CONSISTENT with the seasonal movement of construction volume, price declines have been in evidence in the basic materials since the first of the year.

Most of the fluctuations are local in character and dependent largely upon climatic conditions. A sufficient number are nation-wide in scope to lend weight to the current price movement.

With buying for water-works requirements at seasonal low-ebb, cast-iron pipe prices are down $1 per ton in Pittsburgh, Birmingham, Chicago, San Francisco, and St. Louis, and $2 at New York and Burlington, N. J. Recent declines of 10c. per bbl. occurred in portland cement at Cedar Rapids, Minneapolis, St. Paul and Mason City, Iowa; heavier reductions are also reported in the Hudson River and Boston districts. Pine lumber is up $1 per M ft. at New York on the 3x12 timbers in 20-ft. lengths, while a decline of 50c. and an advance of the same amount occurred in Chicago and Minneapolis, respectively, on Douglas fir timbers.

Western tile is down about 1c. per block but a general upturn is anticipated when the spring shipments begin.

Raw linseed oil at Minneapolis is up 1½c. per 7½-lb. gal., indicating the trend of the market in paint. Turpentine declined recently at New York; red and white lead and putty, however, show no tendency to change. The rise in oil is due to higher flax seed prices, most of the season's product having been marketed.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products									
Structural shapes, 100 lb.	$3.34	$3.80	$4.15	$3.10	$3.35	$3.87½	$3.30	3.15	$4.00
Structural rivets, 100 lb.	4.20	3.80	4.75	3.50	3.75	4.65	5.00	4.00	5.50
Reinforcing bars, ¾ in. up, 100 lb.	3.24	2.80	3.25	2.30@2.50	2.87½	+3.87½	2.95	3.10	3.25
Steel pipe, black, 2½ to 6 in. lap, discount	48%	54%	54%	51%	54.25%	41%	42@53.8%	45%	37.83
Cast-iron pipe, 6 in. and over, ton	—48.60	42.75	56.00	—46.20	53.00	64.00	—48.00	55.00	55.00
Concreting Material									
Cement without bags, bbl.	2.50@2.60	2.35	2.05	2.10	—2.22	2.85	2.31	2.65	1.15
Gravel, ¾ in., cu.yd.	1.75	1.90	2.38	1.85	1.65	1.90	1.80	1.25	1.50
Sand, cu.yd.	1.00	1.60	2.00	1.65	1.25	1.00	1.40	1.25	1.25
Crushed stone, ¾ in., cu.yd.	1.94	2.50	2.83	1.87½	1.75	2.50	1.70	3.00	2.00
Miscellaneous									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	+62@63	34.00	56.00	—40.00	+39.25	34.75	27.00	25.00	50.00
Lime, finishing, hydrated, ton	18.20	23.50	19.00	20.00	25.50	24.00	25.50	24.00	21.00
Lime, common, lump, per bbl.	2.10@3.00	1.50	1.82	1.50	1.70	2.70	1.60	2.80	10.00
Common brick, delivered, 1,000	20.40@22.40	10.50	14.10	12.00	13.75	9@10	15.00	15.00	20.25
Hollow building tile, 4x12x12, per block	Not used	.0895	.112	—.076	.076	.075	.....	09	.10
Hollow partition tile 4x12x12, per block	.1027	.0895	.112	—.076	.076	.075	108	09	.08
Linseed oil, raw, 5 bbl. lots, per 7½-lb. gal.	+.81¾	.90¾	1.10	.84	+.93¾	+1.07	—.95	1.12	1.05
Common Labor									
Common labor, union, hour	.90⅝	.30	.....	90	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	.....	.25	.30@.50	....	.45@.60	40@.45	50	.....	—.25@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent. L.c.l. is less than carload lots.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime in 280-lb. bbl. net and hydrated lime, f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Reinforcing bars (billet steel) and shapes delivered to job in less-than-carload lots.

Labor — Cement and concrete laborers' rate, $1.06½; building laborers, 90⅝c.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber, sand, gravel and stone f.o.b.; price on fir is quoted instead of pine. Reinforcing bars (billet steel) f.o.b. warehouse in carload lots; shapes, less-than-carload lots.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. Bars (billet steel) at warehouse in carload lots; shapes, less-than-carload lots.

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of Jan. 6 the next on Feb. 3.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil delivered in wooden bbl. Common lump lime per 180-lb. net. Bars (billet steel) and shapes, l.c.l.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net. Bars (billet steel) f.o.b. in carload lots; shapes, l.c.l.

Dallas quotes lime per 180-lb. bbl. Cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered. Bars (billet steel) and shapes, l.c.l.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C.-I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common. Bars (billet steel) f.o.b. in carload lots; shapes, l.c.l.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Brick and hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers. Bars (billet steel) and shapes, less-than-carload lots.

Montreal quotes on fir lumber. **Sand,** stone, gravel and lump lime per ton. Stone and tile are delivered; sand, gravel, lime and cement on siding; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 99.843). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½ in., $37.83. Bars (billet steel) and shapes, less-than-carload lots.

Business Briefs

Call money quoted at 4½ per cent, Jan. 17; year ago, 4½ per cent.

Time loans: 60 to 90 days, 4½; 4 to 6 months, 4½ per cent.

Commercial paper: Best names, 4@6 mo., 4¼; others, 4½ per cent.

On Jan. 1, 1927

E. N.-R. Construction Cost Index Number 211.50

E. N.-R. Construction Volume Index Number 188

For Explanation and Details of Indexes Since 1913

See the First Issue of Every Month